# The Engineer

FEBRUARY 7, 1958 28 ESSEX ST., STRAND, LONDON, W.C.2 TWO SHILLINGS



VARICON

PATENTED

**STEPLESS SPEED REDUCER**

**'RADICON' to 'VARICO[illegible]**

**The VARICON stepless mechanical/hydraulic speed reduce[illegible] built by the same manufacturing division as the Radic[illegible] Worm Reducer, with which it shares definite characteristics, and gives an infinite number of speeds between 1/1 and zero for drives up to 5 h.p.**

**It has an extensive range of application in conjunction with the Radicon and also a wide variety of uses as an independent unit. Among its principal features are high efficiency, high power ratings relative to size, smooth speed adjustment either by hand or remote control and exceptionally robust construction.**

**Full details are given in Publication E492.1.d**

THE [redacted]

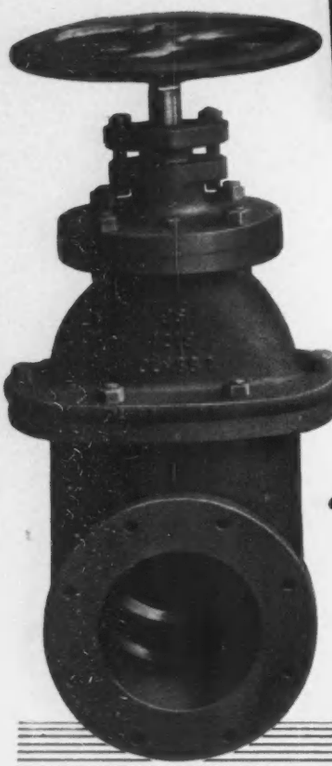
CORPORATION (SALES) LIMITED

RADICON DIVISION

PARK WORKS · HUDDERSFIELD

# *If it's*

# SLUICE VALVES

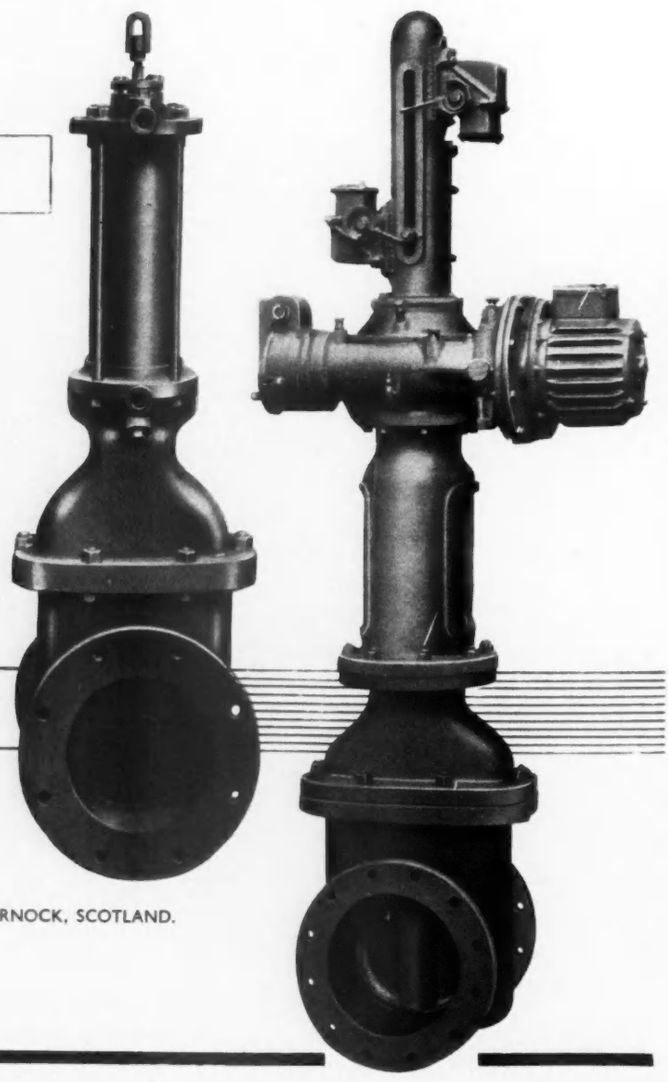


**the Glenfield range offers a complete selection for all duties.**

**Hand Operated forms cover valves for low pressure work to valves capable of withstanding exceptionally high pressures. Generally they are supplied either flanged or socketed, and for direct actuation by cap or handwheel, but other end connections and any type of gearing can be provided to requirements.**

**Power Driven valves are available in a variety of types to suit wide ranges of pressure. Operation can be by electricity, hydraulic pressure and through power relays or automotive devices.**

HAND OPERATED



POWER OPERATED

Glenfield

GLENFIELD & KENNEDY, LIMITED, KILMARNOCK

*Head Office and Works:* KILMARNOCK, SCOTLAND.

# THE ENGINEER

*Established* 1856

No. 5324 **FEBRUARY 7, 1958** **VOL. 205**

## EDITORIAL CONTENTS

**Leading Articles**

"Explorer" in Orbit . . . . . 195
Town's Waste and Derelict Land . . . . . 195
The Dagenham Railway Collision . . . . . 196
"Turboproptosis" . . . . . 196
The State of Shipbuilding . . . . . 197

**Articles**

100 Years Ago . . . . . 197
*Professor Lady Williams* Training of Craftsmen. No. II . . . . . 198
*Tobias and Fishwick* Theory of Regenerative Machine Tool Chatter. No. I . . . . . 199
*Gilmour and Flindt* Engineering Applications of Rigid Foamed Plastics . . . . . 204
*G. A. Isted* Marconi and Microwave Transmission Beyond the Horizon . . . . . 207
*G. Maunsell* Sir Alexander Gibb—An Appreciation . . . . . 209
Industrial Gas-Turbo-Alternator . . . . . 213
Continuous Welded Pipe-Making Equipment . . . . . 214
Shellhaven–Romford Gas Pipeline . . . . . 216
Mobile Materials Handling Plant in a Steel Works . . . . . 217
Aluminium Smelter Plant at Baie Comeau, Canada . . . . . 219
Searching for Minerals in Australia . . . . . 220
Road Schemes . . . . . 221
Training Technicians . . . . . 221
Studying the Economics of Transport . . . . . 221
Institution of Mechanical Engineers . . . . . 221
Collapsible Container . . . . . 221
Fluorescent Lighting Fittings . . . . . 222
18,400kW Germanium Rectifier Installation . . . . . 222
Intrinsically Sealed Rivets . . . . . 223
Small Hand Stacker Truck . . . . . 223
Sensitive Drilling Machine . . . . . 223
Pneumatic Drill with Automatic Feed Control . . . . . 223
Precision Work Chuck . . . . . 224
Small Aircraft Turbine . . . . . 224
Automatic Feed Abrasive Band Machine . . . . . 224

**Continental Section**

Annual Report on Swiss Water Power. European Nuclear Agency and Eurochemic. French Aviation Developments. Cock and Valve Lapping Machine . . . . . 226
Portuguese Iron and Steel Works. Second International Conference for Analogue Computations. German-American Reactor Company. Gas Turbine Conference . . 227

**American Section**

Doubled Power Level of Experimental Boiling Water Reactor. 30,000,000 lb Plate Stretcher. Basic Oxygen Steelmaking Plant . . . . . 228
Deep Drawn Aluminium Containers . . . . . 229

LETTERS Notes on the Use of Resistance Strain Gauges. "An Idea in the Bath" . . . . 210

BOOK REVIEWS . . . . . 210

OBITUARY W. T. Bell. A. E. Hudd. Major F. H. Masters. Sir Holland Goddard . . . . 209

NEWS AND NOTES Industrial and Labour Notes . . . . . 224
Personal and Business. British Patent Specifications. Forthcoming Engagements . 230–232
British Standards Institution . . . . . 203

**INDEX TO ADVERTISERS: PAGE 149** **CLASSIFIED ADVERTISEMENTS: PAGE 139**

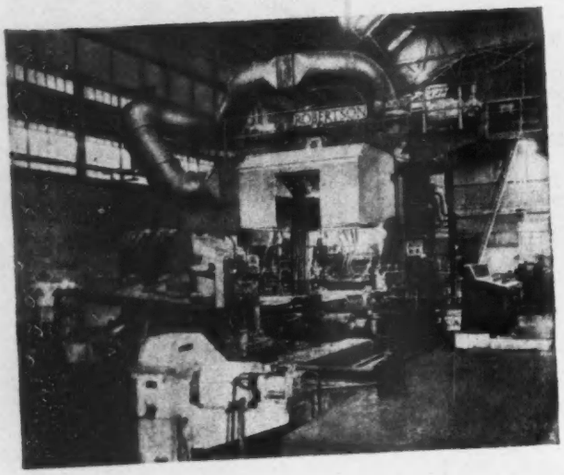
NOTICE TO READERS No undertaking can be given to return illustrations or manuscripts. Correspondents are requested to keep copies. No notice is taken of anonymous communications.

SUBSCRIPTIONS U.K. and ABROAD £5 10. 0. p.a., including postage (CANADA £5 5. 0.). Single copies 2s. each, plus 9d. postage. Also on sale at newsagents.

'THE ENGINEER' BUYERS GUIDE. Published annually. One FREE copy is sent to all direct postal subscribers on publication and delivered by newsagents to all regular readers. Additional copies are obtainable at 7s. 6d. each. Postage 1s. 9d. extra.

*Published every Friday by*
**MORGAN BROTHERS (PUBLISHERS) LTD., at 28, ESSEX STREET, STRAND, LONDON, W.C.2. Telephone: CENtral 6565**

*Photo by courtesy of Messrs. Richard Thomas & Baldwins Ltd.*



# Fume Removal for Steel Works

Another " Visco " fume removal plant at a South Wales steel works is illustrated above. This photograph shows a Robertson four-high reversing mill equipped with " Visco " fume removal plant at the Panteg Works of Richard Thomas & Baldwins, Ltd.

This plant, which has a capacity of 40,000 c.f.m., draws off the fumes generated during the rolling process through hoods on the ingoing and the outgoing sides of the mill. These hoods are fabricated from 3/16in. mild steel plate and incorporate special division plates with spigots. Particular attention has been given to the design and method of supporting the hoods in order to avoid interfering with exhaust piping and other equipment on the mill housings. The hood on the ingoing side has been designed with a cutaway section so that it clears the gate.

The photograph shows the hood on the ingoing side of the mill.

# VISCO

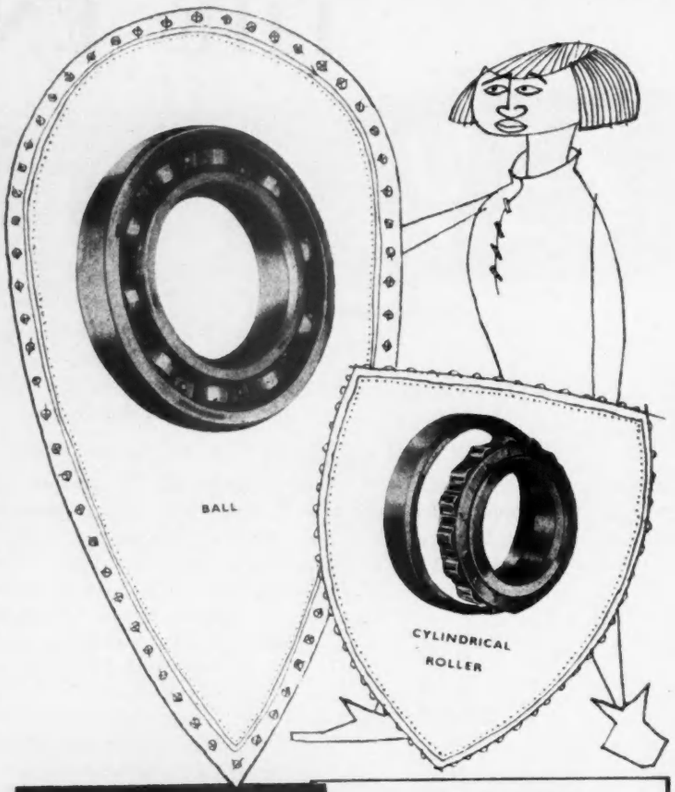
## FUME REMOVAL PLANT

" Visco " fume removal plant for rolling mills, arc furnaces and general steel works purposes has been installed by many important steel manufacturers, including :—

The Steel Company of Wales Ltd.
Thomas Firth & John Brown Ltd.
Whitehead Iron & Steel Co. Ltd.
David Brown Foundries Ltd.
Steel Peech & Tozer Ltd.
Shepcote Lane Rolling Mills Ltd.
C. A. Parsons & Co. Ltd.
Stewarts & Lloyds Ltd.

Our long experience of steelworks fume removal problems is at the disposal of firms interested.

**THE VISCO ENGINEERING COMPANY LTD.**
**STAFFORD RD. CROYDON. 'Phone: CROYDON 4181.**




# RIV

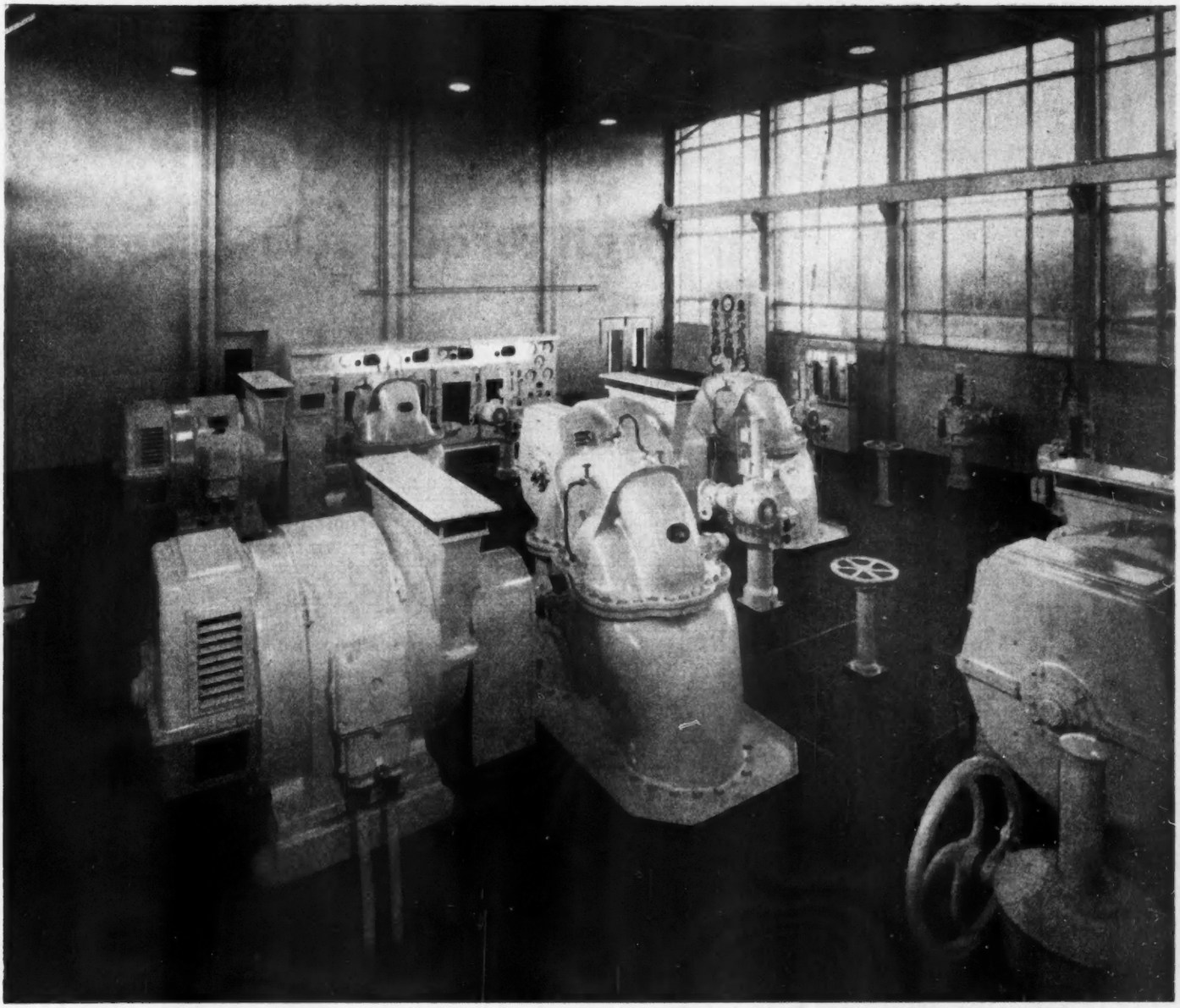
**BALL BEARINGS**
**CYLINDRICAL ROLLER BEARINGS**
**SPHERICAL ROLLER BEARINGS**
**TAPER ROLLER BEARINGS**

**RIV**—the 'hall-mark' known throughout the world, identifying the products of **RIV**, Officine di Villar Perosa, S.P.A., Turin, Italy. **RIV** Bearings, for all applications, have been perfected by long experience. Continuous development assures to the user a product capable of meeting the exacting requirements of modern industrial and manufacturing techniques.

**Sole Concessionaires in the United Kingdom and Eire**

## Revolvo Ltd.

**399-405 Edgware Road, London, W.2**
**Tel: PADdington 4087-8-9**



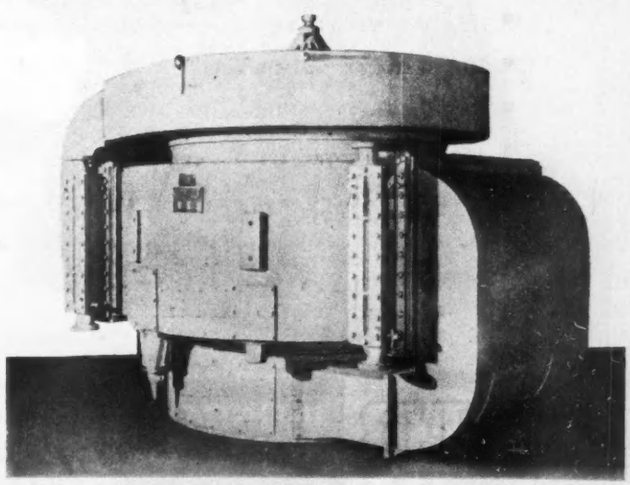
*(Above) Four 320/60 h.p., 660/370 r.p.m., N-S variable speed a.c. motors, with L.S.E. control panels, driving Allen pumps at the Norton pumping station of Liverpool Corporation. (Corporation Water Works Engineer, Mr. J. H. T. Stilgoe, M.Inst.C.E., M.I.W.E.)*

*(Below) A 720 h.p., 420 r.p.m. squirrel-cage motor, weatherproof, water cooled, for circulating water pump drive*

# L.S.E. MOTORS FOR PUMPING DUTIES

**L.S.E. motors are available in types for all pumping duties in water and sewage works, power stations, etc.**

**The N-S variable speed a.c. motor has outstanding advantages for use where efficient variation of pump output is required, under hand or automatic control.**



**LAURENCE, SCOTT & ELECTROMOTORS LTD.**

NORWICH, MANCHESTER, LONDON & BRANCHES.

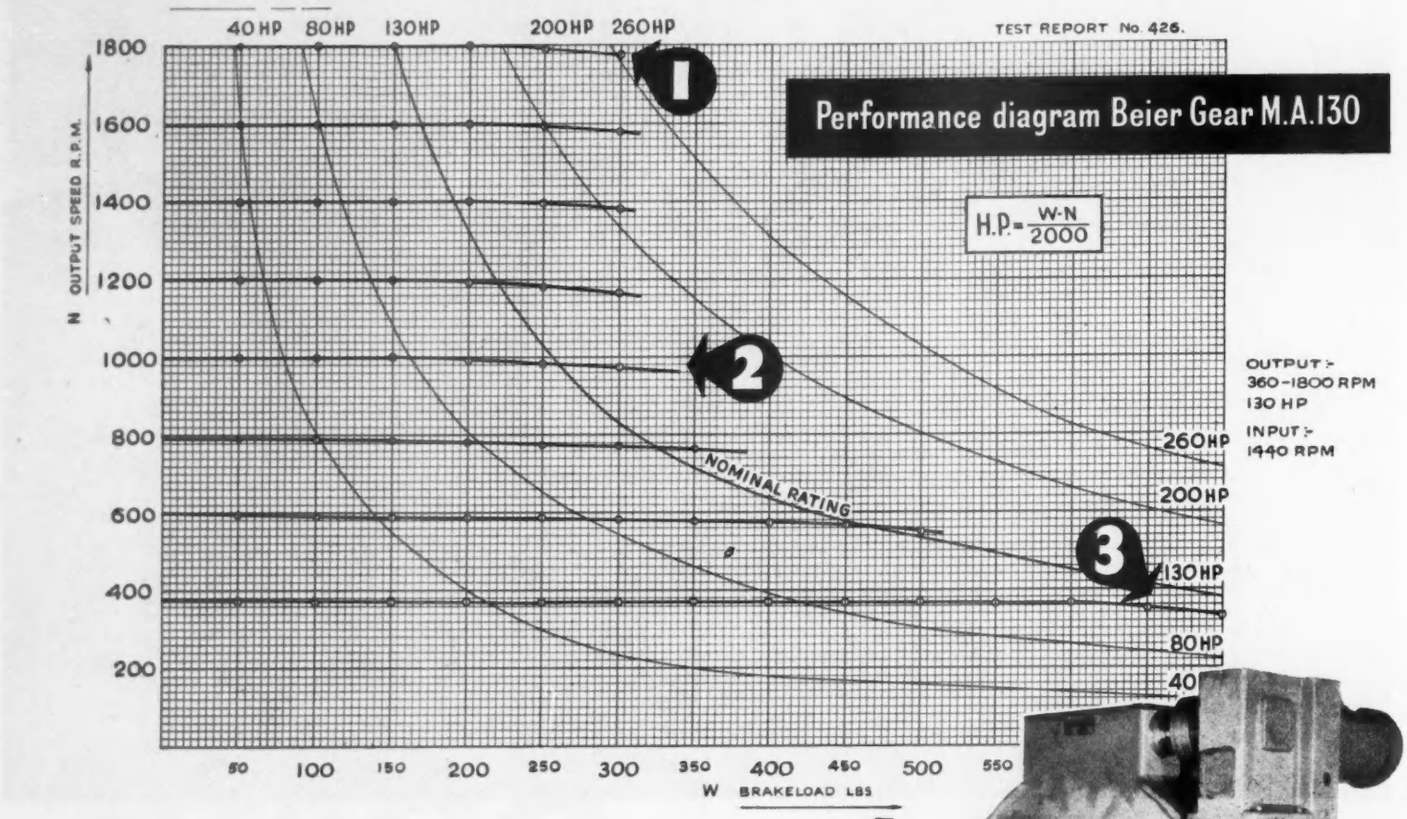
B

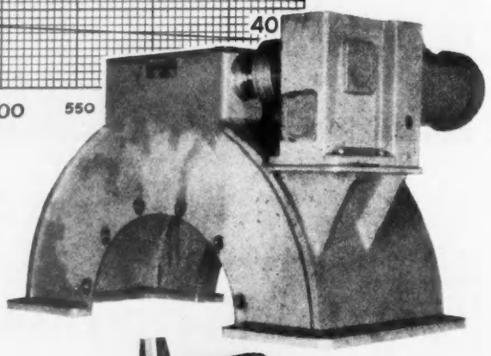
Note these outstanding features

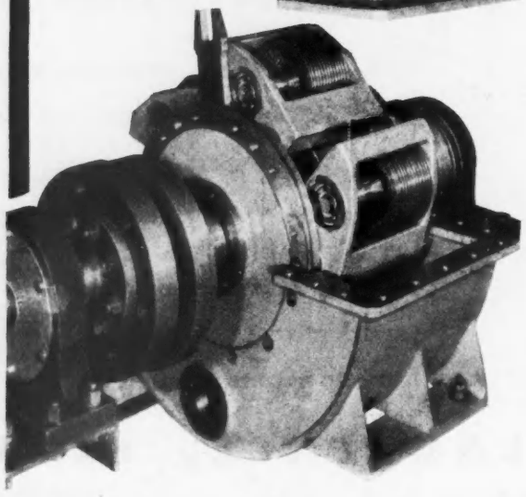
1 High overload capacity

2 Small degree of slip

3 High torque at low speeds





**Other important advantages of Beier Gears are:-**

- *Available from ½ to 300 h.p., with constant horsepower.*
- *Remarkably compact and reliable.*
- *Co-Axial, simplifying transmission.*
- *Mechanical efficiency very high at all speeds.*
- *Numerous transmission points help development of tremendous power.*
- *Oil film between driving and driven members avoids metal to metal contact.*

**BEIER** INFINITELY VARIABLE **GEARS**

*Write for technical leaflet to:* **ARMSTRONG WHITWORTH (Metal Industries) LTD.**
CLOSE WORKS, GATESHEAD, 8, CO. DURHAM.
IN ASSOCIATION WITH JARROW METAL INDUSTRIES LIMITED · WESTERN ROAD · JARROW

# GENERAL FABRICATION

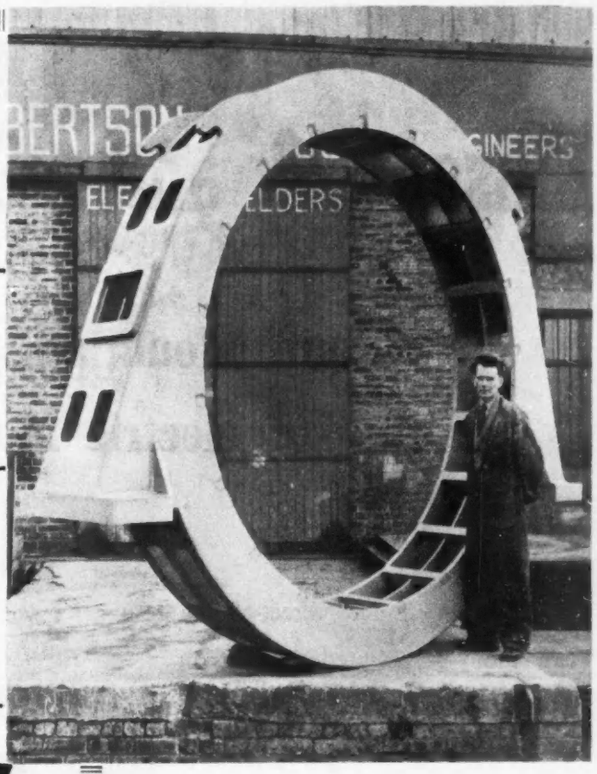
# WELDING

# PROFILE CUTTING

*consult* .....

**ROBERTSON & FERGUSON LTD.**

29, MURIESTON CRESCENT, EDINBURGH, 11 Telephone :— 68501 - 2 - 3

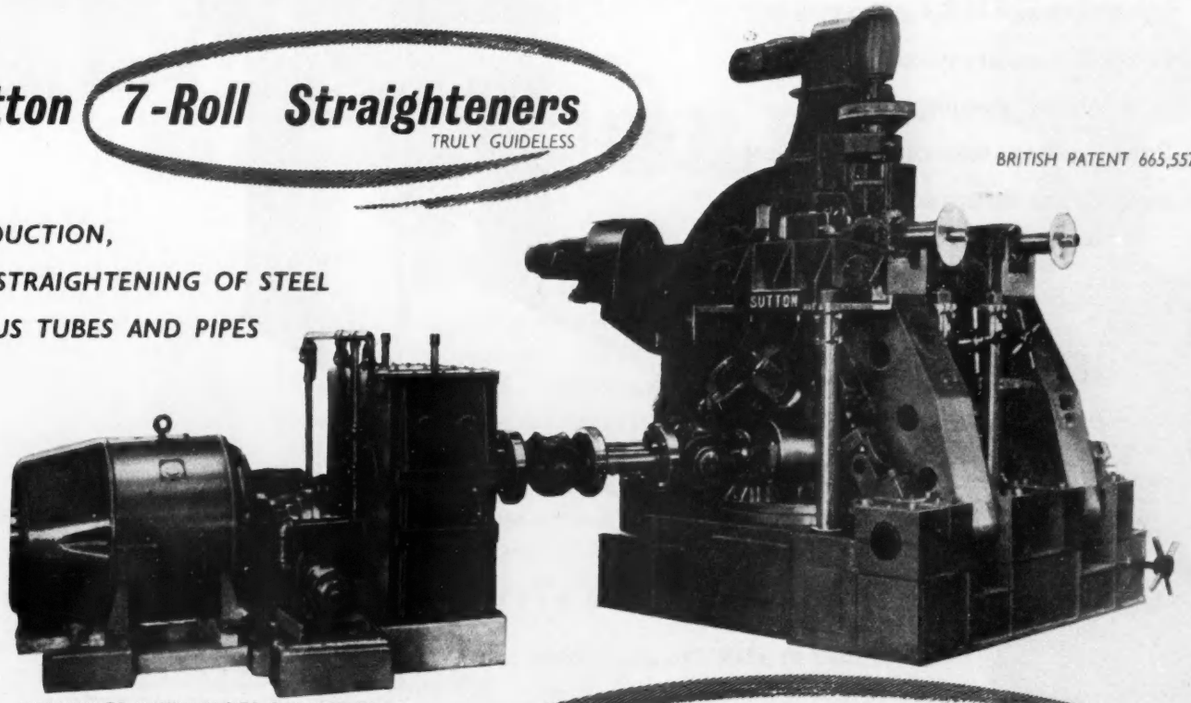


A STATOR FRAME
FOR A SYNCHRONOUS MOTOR
WEIGHT APPROX. 6 TONS.

. . . . *Sutton* **7-Roll Straighteners**
TRULY GUIDELESS

*BRITISH PATENT 665,557*

*FOR HIGH PRODUCTION,*
*HIGH QUALITY STRAIGHTENING OF STEEL*
*OR NON-FERROUS TUBES AND PIPES*




*AVAILABLE IN ALL SIZES FOR 5/16" TO 24" TUBES*

**Exclusive Features**

- *MINIMUM TO MAXIMUM SIZE CHANGEOVER IN LESS THAN FIVE MINUTES.*
- *CONTINUOUS STRAIGHTENING OF TUBES AND PIPES, WITH OR WITHOUT UPSET ENDS.*
- *OPERATES WITHOUT GUIDES.*
- *CAN BE IN LINE WITH TUBE MILL.*
- *SPEEDS UP TO 800 FT. PER MINUTE.*

*NOW MANUFACTURED UNDER EXCLUSIVE LICENCE BY*

**FARMER NORTON**

**SIR JAMES FARMER NORTON & CO. LTD.**

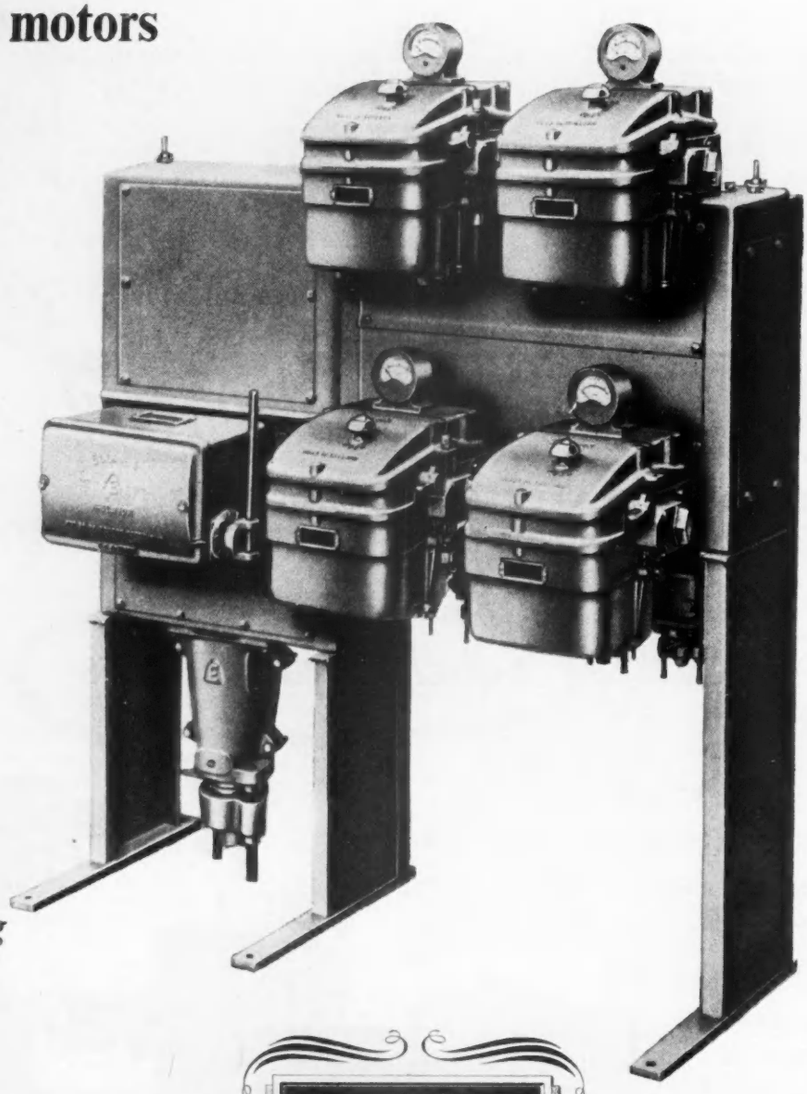
ADELPHI IRONWORKS, SALFORD 3, MANCHESTER
*Telephone : Blackfriars 3613-4-5, 3692-3.* *Telegrams : "Agricola" Manchester.*

# Ellison 20 amp. Circuit Breaker

## For Group Mounting and Sequence Starting of electric motors

The "Ellison" 20 amp. direct-to-line starter can readily be mounted in groups on a busbar chamber. Cable entry may be direct to the busbars by way of a cable fitting or through an isolator or automatic circuit breaker. Extensions are easily made.

This A.S.T.A. tested gear has a built-in isolator in which H.R.C. fuses may be included. Auxiliary switches may also be incorporated for sequence starting. Robust contacts ensure long life under direct-to-line starting conditions.



*With reliable quick-resetting protective devices and safety interlocks*

FOR FURTHER INFORMATION WRITE TO

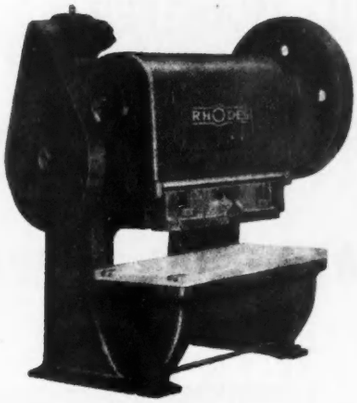
TRADE (E) MARK
GEORGE ELLISON
LIMITED
BIRMINGHAM ENGLAND

739

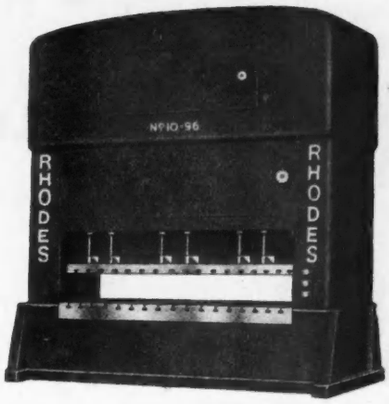
**YOU CAN RELY ON AN ELLISON PRODUCT**

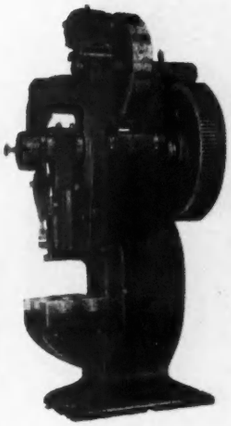
JOSEPH RHODES & SONS Ltd
Of WAKEFIELD ENG. Estab. 1824

THE SPECIALISTS IN PRESS CONSTRUCTION



SOUND · SOLID · ACCURATE · RELIABLE.



NO OTHER PRESSES CAN COMPETE WITH THEM

A RAWLPLUG HEAVY DUTY FIXING DEVICE

RAWLBOLTS

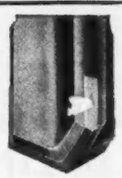
**Tools that save time.** For hole boring there is a big range of high efficiency Rawlplug tools for use by hand, electric and air power.

**RAWLDRILLS**
For hand boring for Rawlbolt sizes A to G.

**STARDRILLS**
For hand boring for all Rawlbolt sizes.

**DURIUM MASONRY DRILLS**
For use in hand and electric drills for Rawlbolt sizes C to G.

**TRIFORM DRILLS**
For use in electric hammers for Rawlbolt sizes C to K.

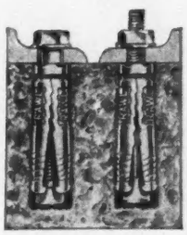


**DURIUM HAMMER DRILLS**
For use in electric hammers for Rawlbolt sizes C to J.

**P. H. BITS**
For use in pneumatic hammers for Rawlbolt sizes E to K.

There is no waiting for cement to harden when you use Rawlbolts. The holes are drilled with a Rawltool to the exact size, the Rawlbolts dropped in and after the machine has been positioned the bolts are tightened. The expansion of the members locks the bolts in the holes. They cannot work loose through vibration or shock. The machine can be put into operation immediately.

Rawlbolts have earned a sterling reputation for strength and reliability throughout the world—they are used by the million every month. Rawlbolts grip by *expansion*—their strength as a fixing is based on the enormous compressive strength of concrete itself.



**RAWLBOLTS ARE MADE IN TWO TYPES**

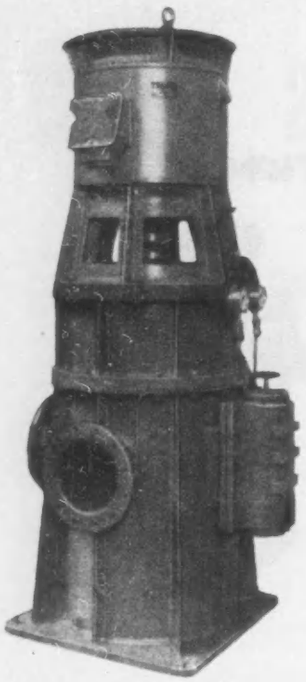
For fixing heavy machinery to floors there is the Loose Bolt type of Rawlbolt which enables the machine to be slid into position after the Rawlbolt has been inserted. For wall fixings use the Bolt Projecting type which will position the fixing before tightening up.

*Please write for Chart and descriptive literature.*

**RAWLPLUG COMPANY LTD., CROMWELL ROAD, LONDON, S.W.7.** | THE WORLD'S LARGEST MANUFACTURERS OF FIXING DEVICES.

## SMOOTH – STEADY – SILENT

# Oil Pumping



Mirrlees IMO Pumps are widely used for main engine forced lubrication and piston cooling aboard ship. In fuel oil burner supply IMO Pumps assist atomisation by producing a steady flow without pulsation.

Positive Displacement · High Speed · Silent Operation · High Suction Lift when necessary · Self Priming.

- **FUEL OIL TRANSFER**
- **FUEL OIL BURNER SUPPLY**
- **LUBRICATING OIL SUPPLY**

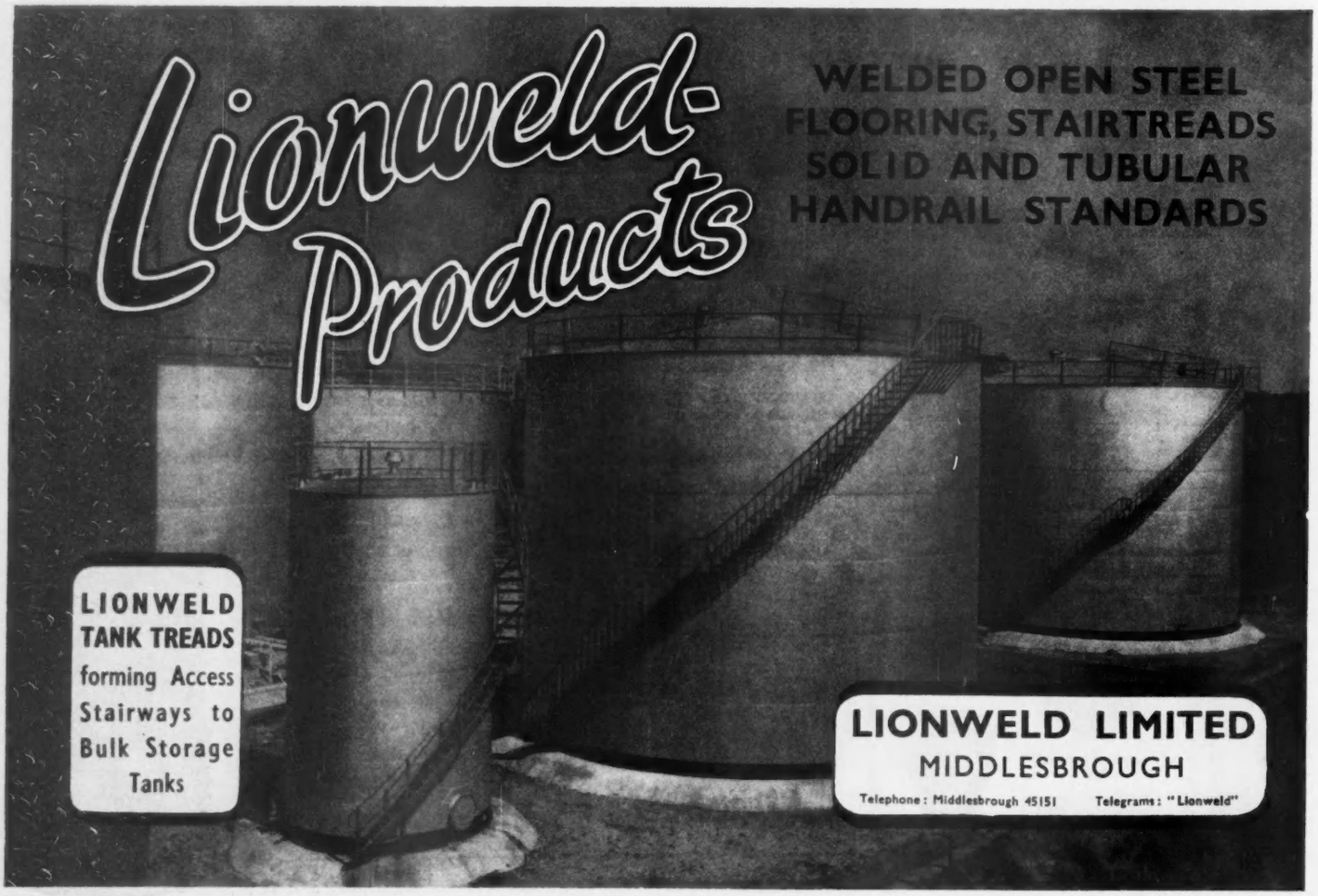
**MIRRLEES (ENGINEERS) LTD.**

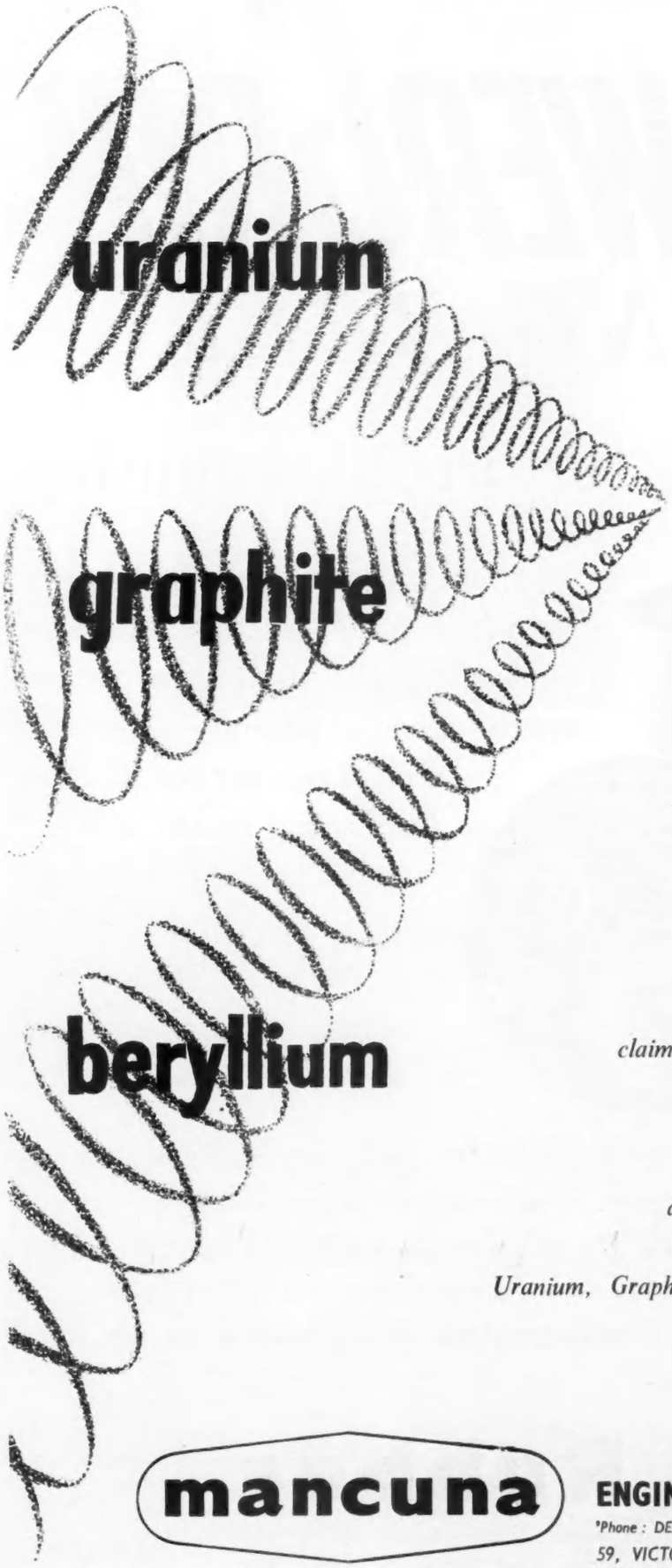
*Subsidiary of the Mirrlees Watson Company Limited*

EARL HAIG ROAD, HILLINGTON, GLASGOW, S.W.2.

London Office: 38, Grosvenor Gardens, S.W.1 Phone: SLOane 6221-2.

MIRRLEES IMO PUMPS


Lionweld-Products
WELDED OPEN STEEL FLOORING, STAIRTREADS SOLID AND TUBULAR HANDRAIL STANDARDS
LIONWELD TANK TREADS forming Access Stairways to Bulk Storage Tanks
LIONWELD LIMITED
MIDDLESBROUGH
Telephone: Middlesbrough 45151 Telegrams: "Lionweld"




high efficiency

# DUST COLLECTION

installations

*As a company, we can already claim unique experience in the design of the highly specialised dust collection installations in Uranium, Graphite and Beryllium Machine Shops.*

mancuna

**ENGINEERING LTD., DENTON, MANCHESTER.**

'Phone : DENton 3965 (5 lines).

59, VICTORIA ROAD, SURBITON, SURREY. 'Phone : Elmbridge 9793.

HEATING · VENTILATING · FILTRATION · AIR CONDITIONING · HUMIDITY CONTROL ETC.

US RUBBER

# POWERGRIP TIMING BELT

*Acknowledgement to The Colchester Lathe Co. Ltd. for photograph showing* **POWERGRIP** *timing belt drive.*

## for precision finishes

Positive elimination of slip and creep • No initial tension • Compactness in width and pulley diameter • No belt stretch—needs no take-up—will operate on fixed centres • High operating speeds • Constant angular velocity • No lubrication required • High mechanical efficiency—very nearly 100% • Light or heavy drives—1/100-300HP.

**With the spindle directly driven by a POWERGRIP timing belt, this 5″ Chipmaster high-speed precision lathe is able to turn work to the very finest degree of finish.**

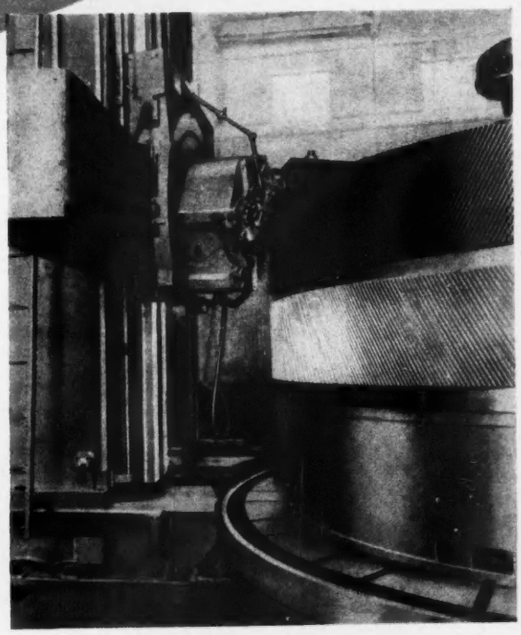
**The low speed range is obtained from the geared headstock, but for the high speed range, all gearing is disengaged and the spindle is driven directly by a POWERGRIP timing belt. This gives a positive non-slip drive, eliminating vibration and ensuring the production of precision finishes of the highest order.**

US RUBBER **U. S. Rubber**

Home: *The North British Rubber Company Limited. ABBey 7135*
Export: *U.S. Rubber International (Great Britain) Ltd. ABBey 2053*

**62/64 HORSEFERRY ROAD, LONDON, S.W.1**

# Of the highest standard

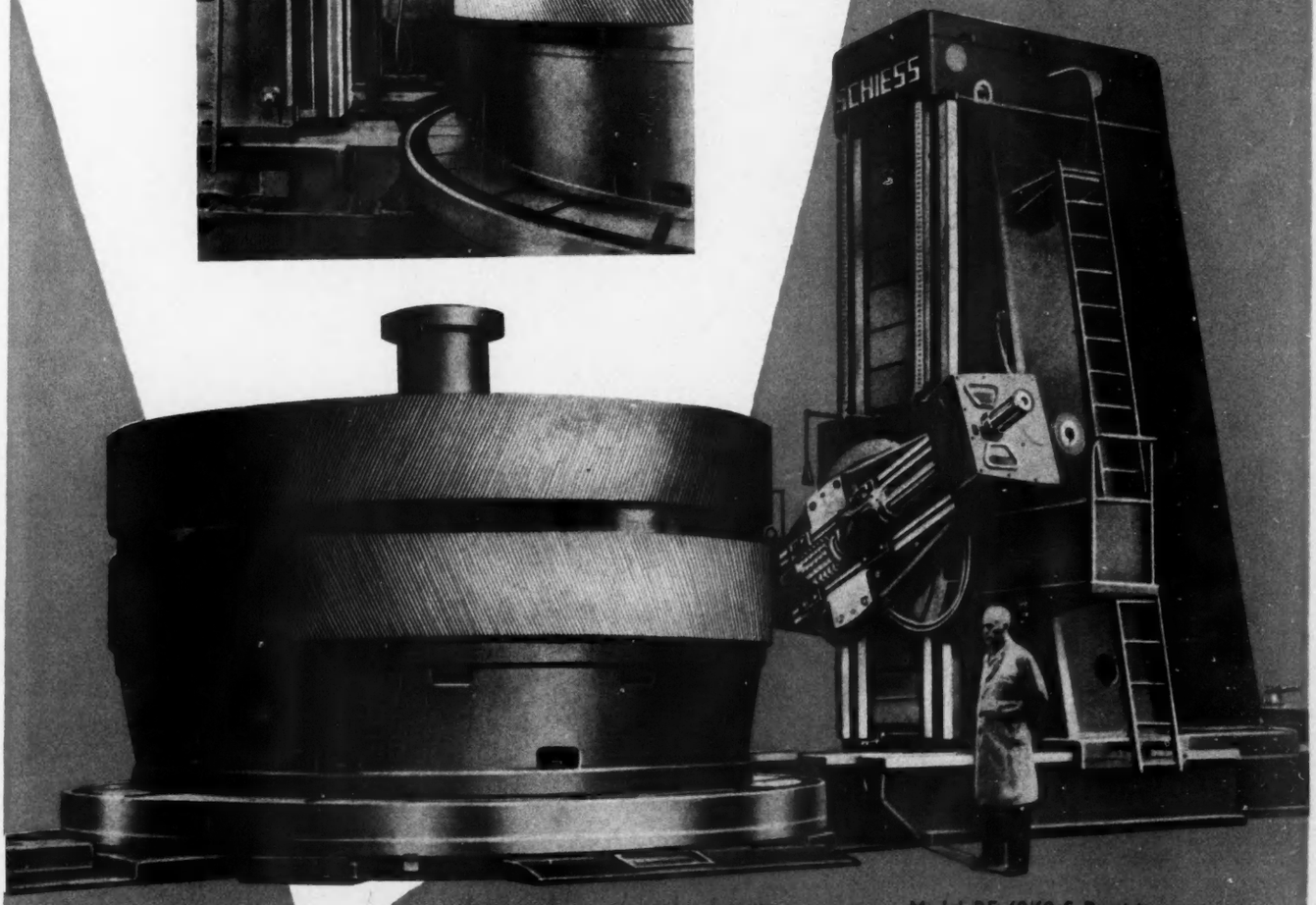


## for accuracy and productive capacity

Our Gear Hobbing Machines, built in air conditioned temperature controlled workshops, meet all demands for extreme accuracy and highest output.

These machines are top quality products in the world of gearhobbing.

Write for catalogues on RF wheel machines and RFw pinion machines.



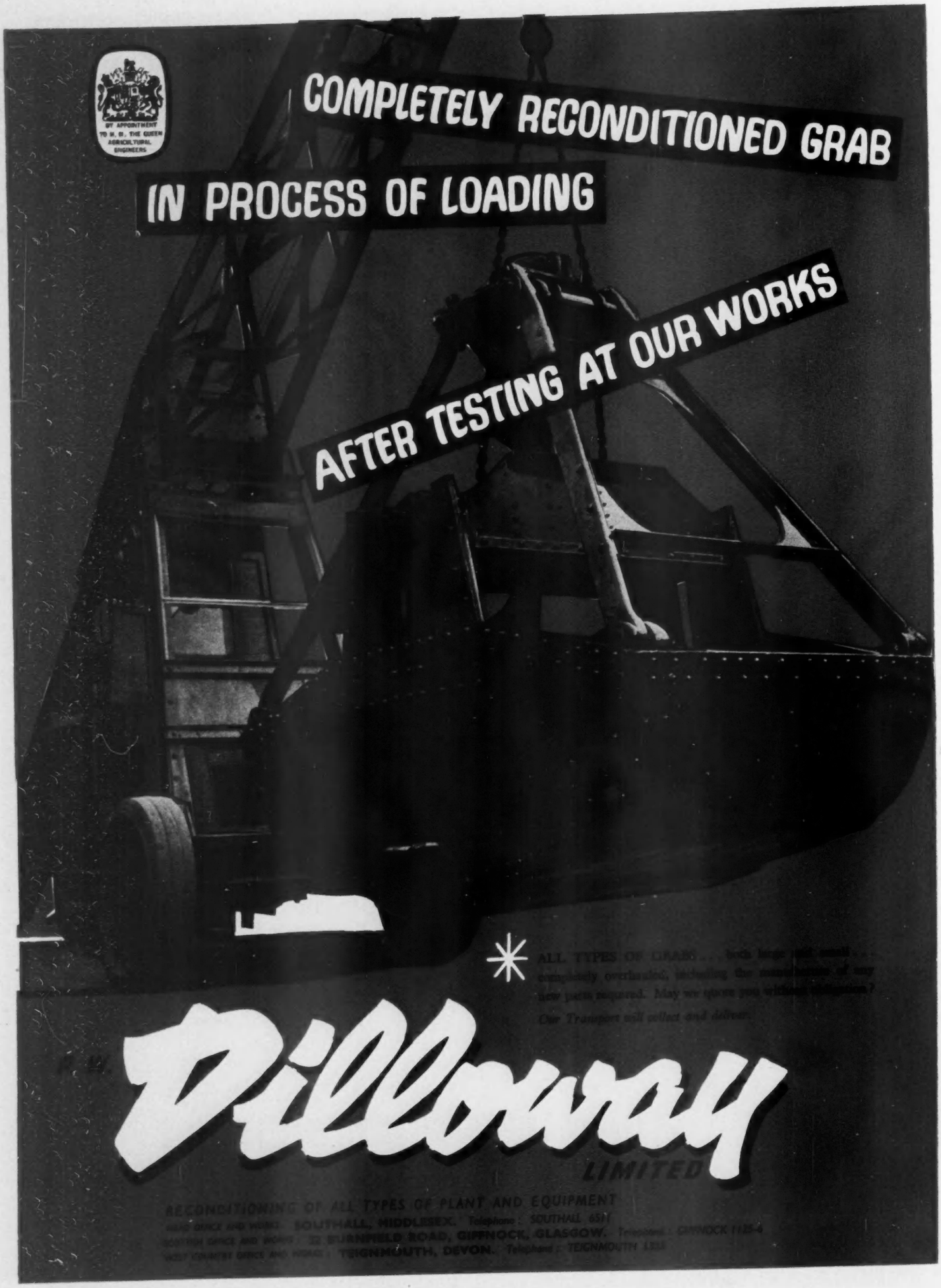

Model RF 40/60 S Precision Gear Hobbing Machine for Turbine Reduction Gears.

**SCHIESS AKTIENGESELLSCHAFT DÜSSELDORF**

6209

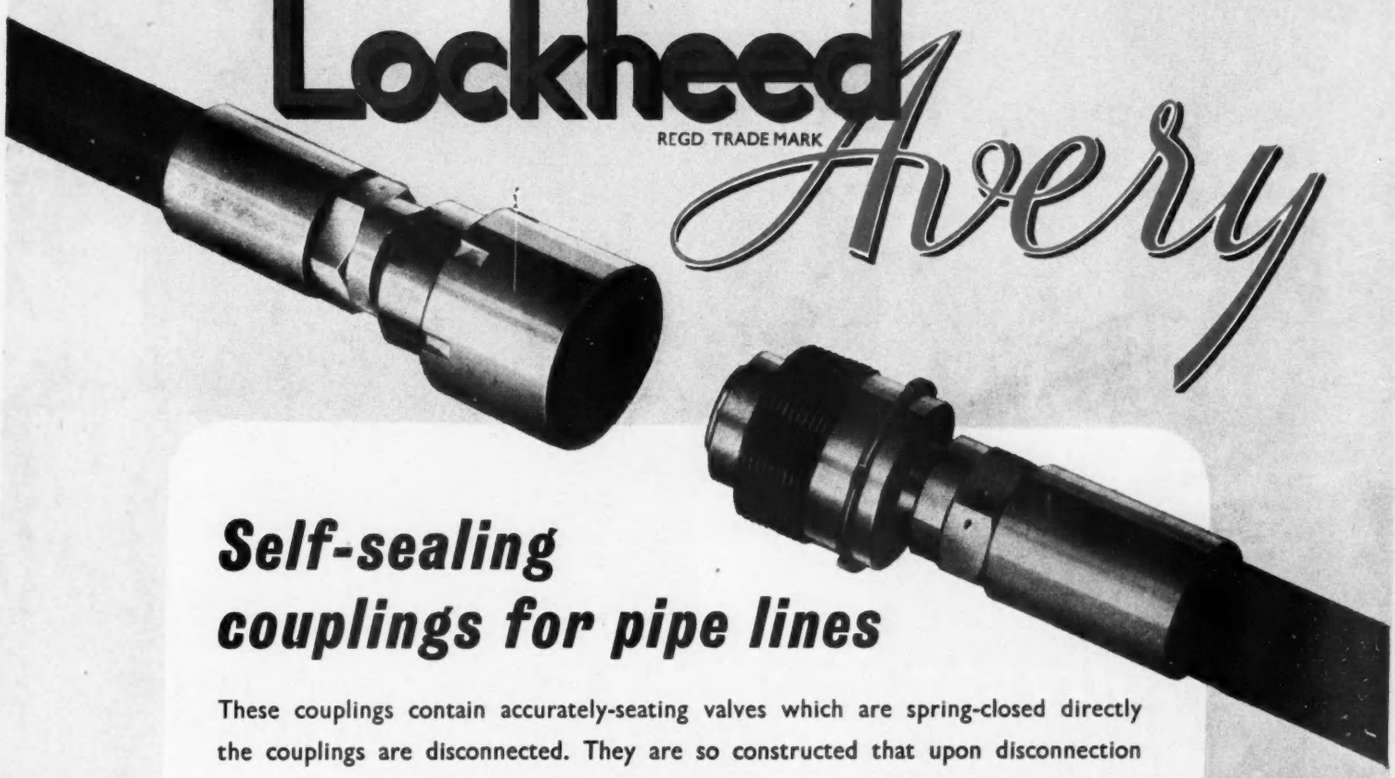
Sole Agents United Kingdom and Eire. **ALFRED HERBERT LTD. COVENTRY**

C


BY APPOINTMENT TO H. M. THE QUEEN AGRICULTURAL ENGINEERS
COMPLETELY RECONDITIONED GRAB
IN PROCESS OF LOADING
AFTER TESTING AT OUR WORKS
ALL TYPES OF GRABS . . . both large and small . . . completely overhauled, including the manufacture of any new parts required. May we quote you without obligation?
Our Transport will collect and deliver.
Dillonway
LIMITED
RECONDITIONING OF ALL TYPES OF PLANT AND EQUIPMENT
SOUTHALL, MIDDLESEX. Telephone: SOUTHALL 6511
32 BURNFIELD ROAD, GIFFNOCK, GLASGOW. Telephone: GIFFNOCK 1125-6
TEIGNMOUTH, DEVON. Telephone: TEIGNMOUTH 1333

# Lockheed Avery

REGD TRADE MARK



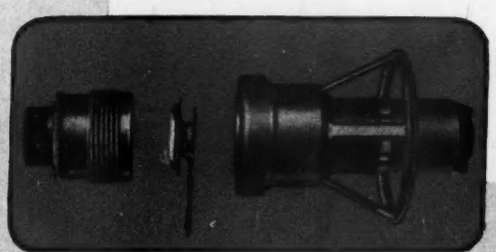
## Self-sealing couplings for pipe lines

These couplings contain accurately-seating valves which are spring-closed directly the couplings are disconnected. They are so constructed that upon disconnection there is no spillage of the contents of the hose and no entrapping of air. The hoses are made in various qualities and sizes, some are available for very high pressure, fire-proof when required, and they lend themselves to a great many applications for air and gases under pressure, for oil, fuel and hydraulic fluid.

More than a million of these fittings have been supplied, and they have been standardized on all British aircraft and for British Railways for the refuelling equipment on diesel locomotives. Used in this way, the couplings give the most efficient form of refuelling, being connected and disconnected in a fraction of a minute; there is no need to up-end the hose and there is no loss of fuel. The self-sealing couplings screw on to standard pipe end-fittings.

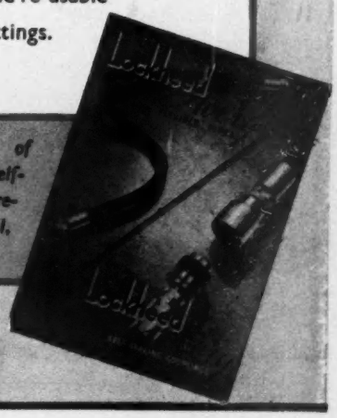
**Lockheed-Avery**
**FLEXIBLE PIPES**

are made in a wide range of sizes and types. They are of high quality, ranging up to the special types used upon aircraft; they have easily detachable and re-usable end fittings.



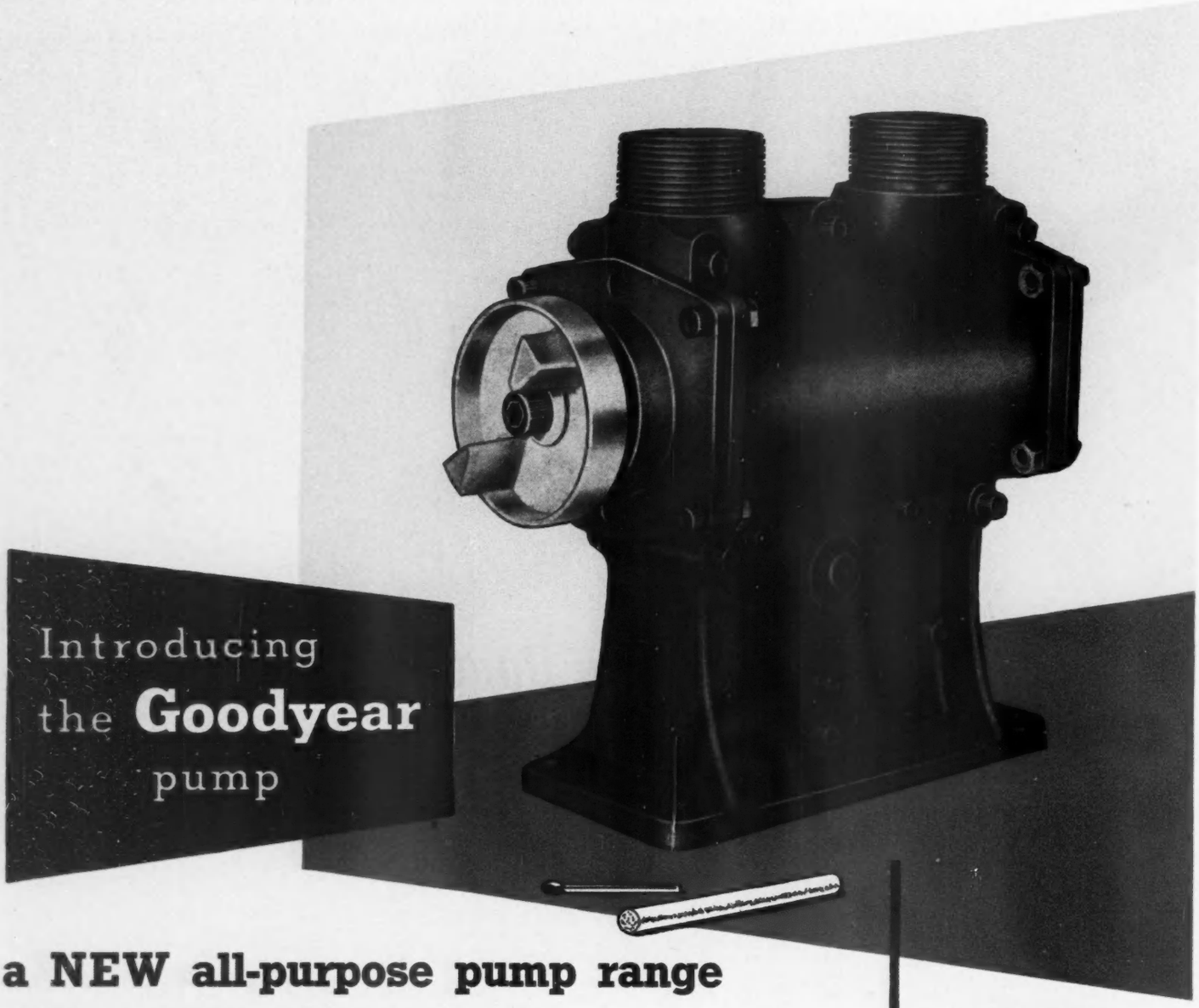
*Typical Lockheed-Avery refuelling connections, shown disconnected.*

*The comprehensive catalogue of Lockheed-Avery flexible hoses, self-sealing couplings and pressure-replenishing connections for fuel, oil, etc., will be sent on application.*



AUTOMOTIVE PRODUCTS COMPANY LIMITED
LEAMINGTON SPA, WARWICKSHIRE, ENGLAND

ON APPROVED LISTS OF THE ADMIRALTY, MINISTRY OF SUPPLY AND AIR MINISTRY




# a NEW all-purpose pump range

*with exceptional performance*

## e.g 30 galls. per min. at 200 ft. head

The unique design has resulted in a machine of such remarkable efficiency and small specific size (it is only 8 in. high) that it will reliably perform duties usually requiring much larger pumps.
GOODYEAR is a continuous self-priming, self-lubricating pump of extreme simplicity with a remarkable wide speed range. It is an axial-flow unit employing a screw of entirely new design. All engaging surfaces are rubber-to-metal, fluid-lubricated—reducing frictional loss to an absolute minimum. It can be supplied in Light Alloy for portable use, Meehanite for process pumping and Bronze for marine work.

★ **Self-priming**

★ **Self-lubricating**

★ **Will run on 'snore' indefinitely**

★**Delivery pressures up to 85 p.s.i. or 200 ft. head per stage (higher in approved cases) can be employed and suctions of 27½ in. of mercury are possible.**

| Overall Height | ins. | mm. |
|---|---|---|
| With Relief Valve | 10 | 254 |
| Without Relief Valve | 8 | 203 |
| Maximum width | 4 | 102 |
| Maximum length | 9 | 229 |
| Weight 20 lb. (9 kgs.) | | |

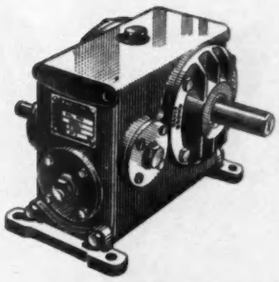
**Goodyear** **the small pump with the big heart**

**GOODYEAR PUMPS LIMITED, Camborne, Cornwall. Telephone: Camborne 2275**

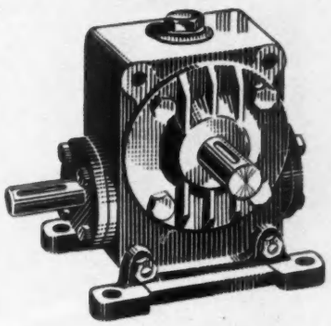
One of the companies of the world-wide Holman Organisation, which has agents, branches and technical representatives throughout the U.K. and in 84 other countries.

GYI

# Consider my position



With so many mounting positions, and such a wide choice of ratios, the compact and highly efficient Radicon Worm Reducers are in demand for a seemingly endless variety of industrial applications. Built by acknowledged experts in gears and gearing, Radicons are famous for their endurance and reliability with an absolute minimum of maintenance. For useful and comprehensive data, send for Catalogue No. E.387-96.B



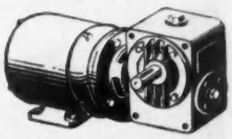
**RADICON**
WORM REDUCERS 1⅛ 1⅝ 2¼

**40 alternative mounting positions**

**64 ratios 5:1 to 3600:1**

**Highest value at competitive prices**

*Also available as motorised units*



THE **DAVID BROWN** CORPORATION (SALES) LIMITED
**LONDON GEAR DIVISION** Stonebridge Park Works Nth Circular Road London NW10 Elgar 6824



# NOT a case for

## "MAKE DO AND MEND"

*When Barimar received this powerful straightening press the top was broken right off. The broken piece weighs* 15-cwt.

***A "temporary repair" only serves its purpose awhile, but BARIMAR WELDING IS PERMANENT!***

*MAKE DO AND MEND* in domestic life may serve its purpose excellently, but in the strenuous realms of engineering, more often than not, it is a forlorn hope. At a pinch, a temporary repair to a damaged machine may stave off the inevitable but in the long run, expert attention surely saves the day. This was so in the case of this powerful straightening machine engaged in turning out a wide range of crankshafts—work of first-rate importance.

The top of the press was broken off completely. The fracture was 8½ ft. long, and the metal 1⅛ ins. thick. A serious breakage, this, in a casting weighing over 3-tons : the broken piece alone was 15-cwt. in weight.

As a temporary measure, the machine had been operating on a reduced load, held together with thick plates and strong bolts. This was unsightly and unsatisfactory. The owners wanted a permanent and dependable repair, so they contacted Barimar. After accurate setting up at the Barimar Works, a strong, firm weld was made of all fractures, the uncertain and unsightly plates were removed and the press was back on the job within seven days. This powerful straightening press was actually reinforced for its exacting duties, *and* as a first-class piece of *Scientific Welding*, the repair was covered by *The Barimar Money-back Guarantee.*

Barimar repaired and reinforced this straightening press by Scientific Welding, and returned it to the Owners along with the Barimar Money-back Guarantee, ready to resume its vitally important work.

*BROKEN PARTS* sent by Rail or by Road Transport must be Carriage Paid. Please post instructions. Parts too heavy to transport can be repaired on site by Barimar's Mobile Plants.

**BARIMAR** LTD.
**Barimar House, 22-24, Peterborough Road, FULHAM, LONDON, S.W.6**
Telephones: RENown 2147-2148. Night 2148. Telegrams: "Bariquamar, Walgreen, London"
*BRANCH ADDRESSES:* BIRMINGHAM 12: 116-117, Charles Henry Street *Tel.: Midland* 2696 MANCHESTER 13: 67, Brunswick Street, Ardwick *Tel.: Ardwick* 2738
NEWCASTLE UPON TYNE 1: 64-66, The Close *Tel.:* 21055 GLASGOW C.2: 134, West George Lane *Tel.: Central* 4709

*BARIMAR—THE WORLD'S SCIENTIFIC WELDING ENGINEERS*

**TWW—*an essential part of the industrial scene***

1. Dismantling
2. Structural Steelwork
3. Steel Stockholding
4. Cement
5. Iron & Steel Scrap
6. Wagon Building & Repairs
7. Machinery
8. Rails & Sidings
9. Contractors' Plant — Sale & Hire
10. Tractors
11. Road Surfacing Materials
12. Power Plant & Pumps
13. Industrial Plant

**Other Ward activities include:-**

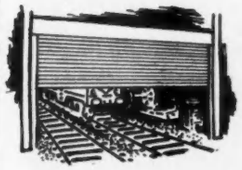
*Shipbreaking*
*Materials Handling Equipment*
*Factory Planning & Installation*
*Foundry Plant & Supplies*
*Insulating Materials*
*Food Preparing Machinery*

**THOS. W. WARD LTD**

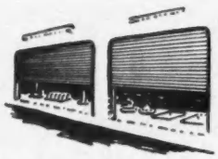
**ALBION WORKS · SHEFFIELD**

*London Office:—* Brettenham House, Lancaster Place, Strand W.C.2.

GP/80

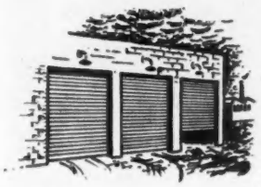


**LOADING BAYS**
Shutters for everyday use - designed to give good closure and long life.



**CANTEEN COUNTERS**
Shutters and grilles for bars and counters designed with an eye to appearance.

**KINNEAR SHUTTERS**
***FOR TROUBLE-FREE OPERATION***



**FACTORY ENTRANCES**
Shutters giving complete weather protection, easy operation; single doors or in series.

*Write for informative literature to Dept. 7B.*

ARTHUR L. GIBSON & CO. LTD
TWICKENHAM, MIDDLESEX.
TEL. POPESGROVE 2276 BIRMINGHAM HIGHBURY 2804
GLASGOW HALFWAY 2928 MANCHESTER CENTRAL 1008

**GANDY**
**NYLON TRANSMISSION BELTING**

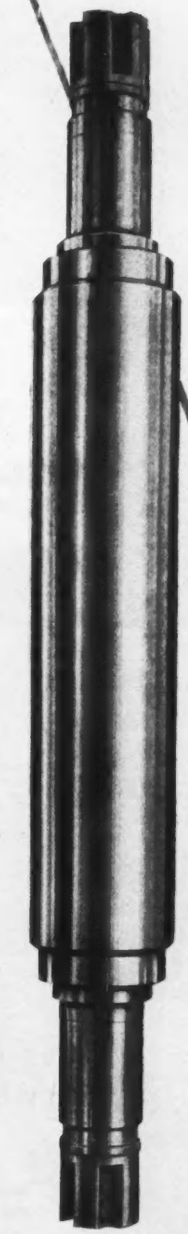
After 3½ years continuous service this nylon warp belt (installed at a quarry) is still in as good condition as the day it was put on. In situations where ordinary belting wears through in very little time Gandy nylon belting provides the complete answer.

**GANDY LTD.,**
**WHEATLAND WORKS, SEACOMBE, WALLASEY, CHESHIRE.**
**Telephone: WALlasey 9574 (5 lines)**
**Telegrams: "GANDY, BIRKENHEAD"**

**SEND FOR LEAFLET**

**Depots at London, Manchester, Birmingham, Leeds, Glasgow, Belfast and Dublin**

**DEW**



**DEUTSCHE EDELSTAHLWERKE AKTIENGESELLSCHAFT**
**KREFELD (GERMANY)**
A.I.D. APPROVED

**FORGED STEEL ROLLS**
**FOR THE COLD ROLLING OF SHEET AND STRIP MATERIAL**

**ROLLS AND ROLLERS**
**FOR STRAIGHTENING AND PLANISHING STANDS**

**ROLLERS**
**FOR THE PRODUCTION OF TUBES FROM STRIP MATERIAL**

AGENTS FOR GREAT BRITAIN: MARATHON FINE STEELS LTD
ABBEY HOUSE 2-8 VICTORIA STREET
LONDON, S.W.1
CABLES: MARAFINE SOWEST LONDON
TELEPHONE: ABBEY 1150

HAMMERED OR
HYDRAULIC PRESSED

**FORGINGS**

IN STEEL
BLACK OR MACHINED
TO 24 TONS

INCE FORGE CO. WIGAN
PARKS FORGE LTD
PROPRIETORS

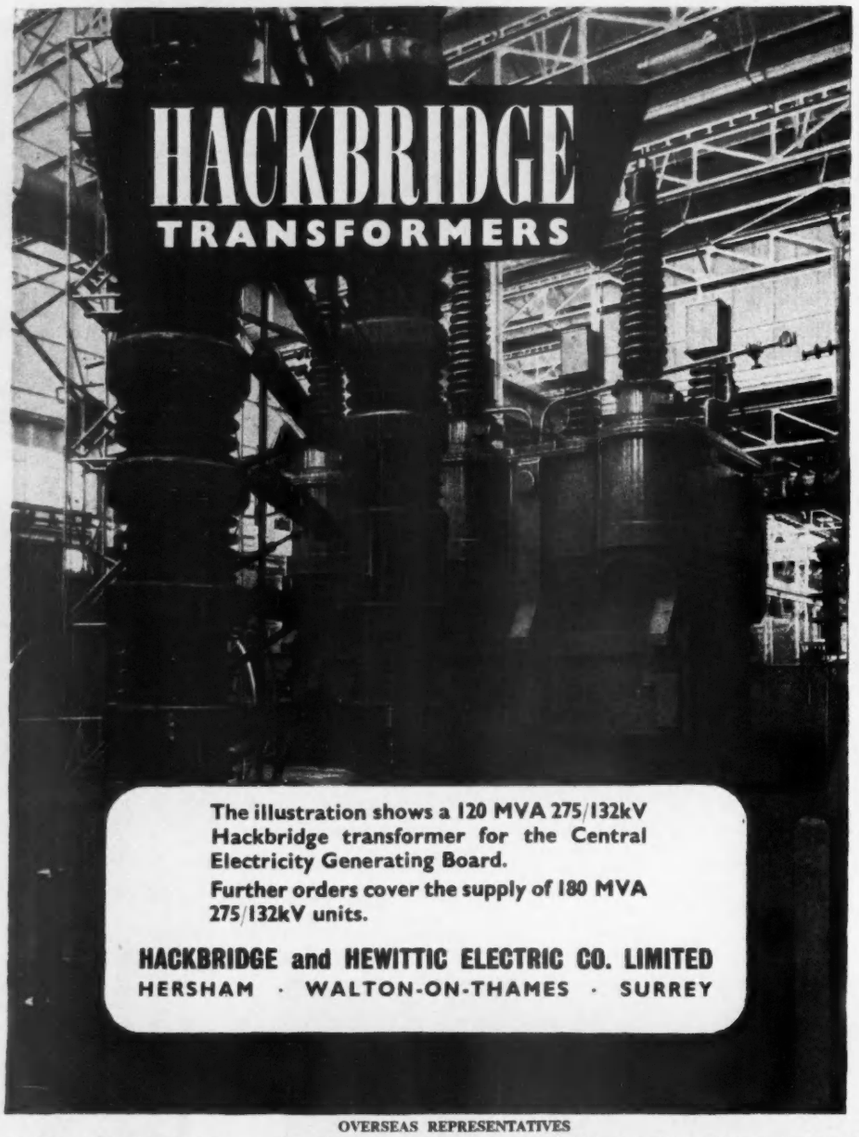
BRAND NEW
BALL & ROLLER
BEARINGS
OVER 4 000 000 IN STOCK
IN MORE THAN 4 000 TYPES

BRITAIN'S LARGEST STOCKS
Consisting of HOFFMANN, R. & M., S.K.F., F.B.C., POLLARD, TIMKEN, TORRINGTON, HYATT, M.R.C., N.D., FAFNIR, FAG., RIV., STEYR, G.M., S.R.O., A.K.F., ONA, GIUSTINA, ETC. ETC.

SUPPLIERS TO AIR MINISTRY, MINISTRY OF SUPPLY, ADMIRALTY, NATIONAL COAL BOARD, PUBLIC UTILITY UNDERTAKINGS, OVERSEAS GOVERNMENTS, ETC. ETC.

Exporters to all parts of the World.
Write for New Stock List.

CLAUDE RYE BEARINGS
895-921 FULHAM ROAD, LONDON, S.W.6
RENOWN 6174 (EXT. 24) TELEX 2-7453




The illustration shows a 120 MVA 275/132kV Hackbridge transformer for the Central Electricity Generating Board.

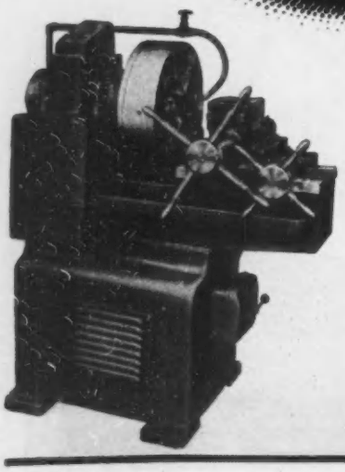
Further orders cover the supply of 180 MVA 275/132kV units.

HACKBRIDGE and HEWITTIC ELECTRIC CO. LIMITED
HERSHAM · WALTON-ON-THAMES · SURREY

OVERSEAS REPRESENTATIVES

ARGENTINA : H. A. Roberts & Cia., S.R.L., Buenos Aires. AUSTRALIA : Hackbridge and Hewittic Electric Co. Ltd., 171, Fitzroy Street, St. Kilda, Victoria ; N.S.W. : Queensland : W. Australia : Elder, Smith & Co. Ltd., South Australia : Parsons & Robertson Ltd. ; Tasmania : H. M. Bamford & Sons (Pty.) Ltd., Hobart. BELGIUM & LUXEMBOURG : M. Dorfman, 5 Avenue des Phalenes, Brussels. BRAZIL : Oscar G. Mors, Sao Paulo. BURMA : Neonlite Manufacturing & Trading Co. Ltd., Rangoon. CANADA : Hackbridge and Hewittic Electric Co. of Canada Ltd., Montreal ; The Northern Electric Co. Ltd., Montreal, etc. CEYLON : Envee Eas Ltd., Colombo. CHILE : Sociedad Importadora del Pacifico Ltda. Santiago. EAST AFRICA : Gerald Hoe (Lighting) Ltd., Nairobi. EGYPT : Giacomo Cohenca Fils, S.A.E., Cairo. FINLAND : Sahko-ja Koneliike O.Y. Hermes, Helsinki. GHANA, NIGERIA & SIERRA LEONE : Glyndova Ltd. NETHERLANDS : J. Kater E.I., Ouderkerk a.d. Amstel, Amsteldijk Noord 103c. INDIA : Steam & Mining Equipment (India) Private Ltd., Calcutta ; Easun Engineering Co. Ltd., Madras, 1. IRAQ : J. P. Baboshy Bros., Baghdad. MALAYA, SINGAPORE & BORNEO : Harper, Gilfillan & Co. Ltd., Kuala Lumpur. NEW ZEALAND : Richardson, McCabe & Co. Ltd., Wellington, etc. SOUTH AFRICA : Arthur Trevor Williams (Pty.) Ltd., Johannesburg, etc. CENTRAL AFRICAN FEDERATION : Arthur Trevor Williams (Pty.) Ltd., Salisbury. THAILAND : Vichien Phanich Co. Ltd., Bangkok. TRINIDAD & TOBAGO : Thomas Peake & Co., Port of Spain. TURKEY : Dr. H. Salim Oker, Ankara. U.S.A. : Hackbridge and Hewittic Electric Co. Ltd., P.O. Box 234, Pittsburgh 30, Pennsylvania. VENEZUELA : Oficina de Ingenieria Sociedad Anonima, Caracas.

HEAP'S



UNIVERSAL SCREWING MACHINES

with Patent Tangential Die Heads

A general purpose machine, capable of handling a wide variety of Pipe and Bolt work at a very low die cost. Tangential Die Head with quick opening and closing device, . . . no nuts to unscrew.

Life of Tangential Dies 15 to 20 times that of ordinary Dies.

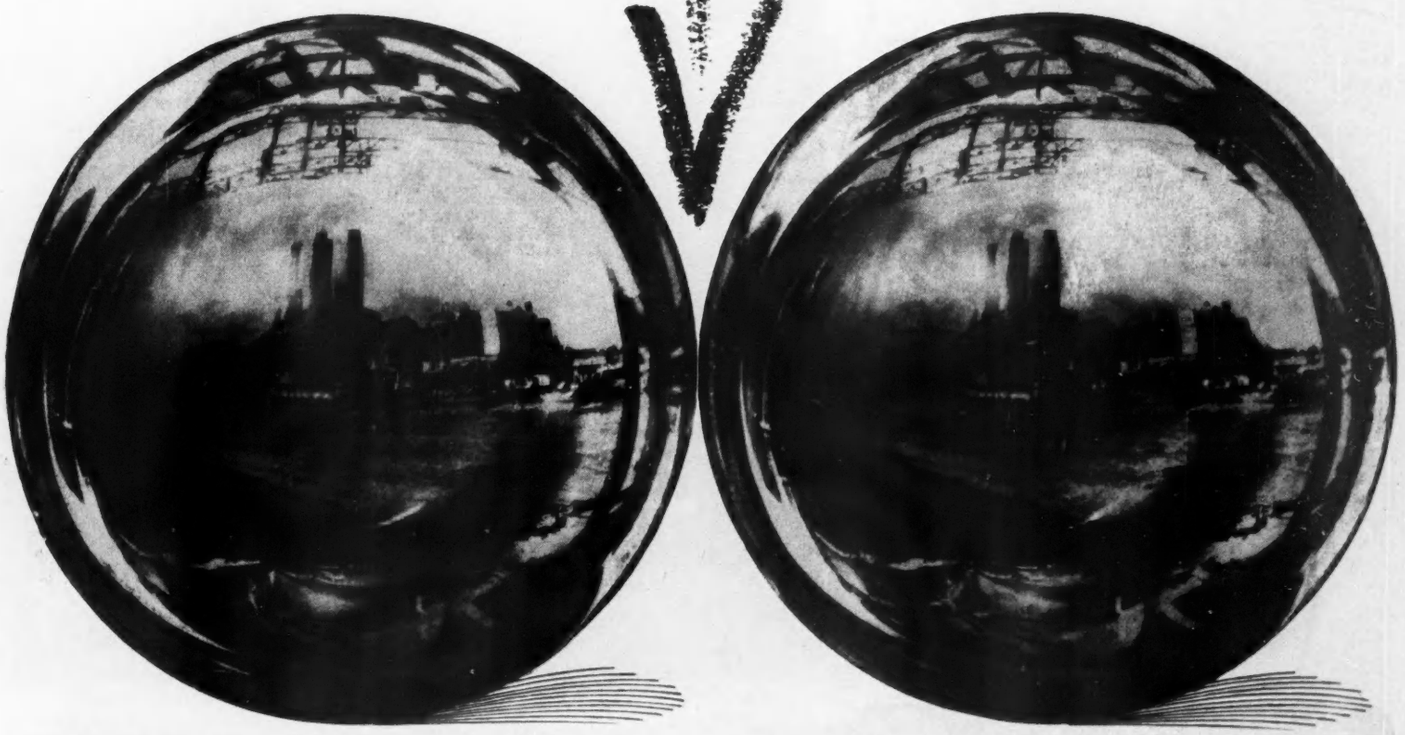
Capacity from ¼in. to 4in. B.S.P. of ¼in. to 2in. Bolts.

JOSHUA HEAP & Co. LTD ASHTON-UNDER-LYNE, ENGLAND

# Lubrication Plus Protection

*Mobilux Grease* is a lithium-base lubricant of excellent structural stability and purity. It is a new, general-purpose grease superseding conventional greases. It provides effective lubrication for the majority of grease applications over a temperature range from minus 20°F to 250°F. It is exceptionally resistant to water washing and contains special additives to prevent rust formation. Both in the laboratory and in the field Mobilux Grease has proved its outstanding efficiency as a lubricant and protector.

**MOBILUX GREASE**

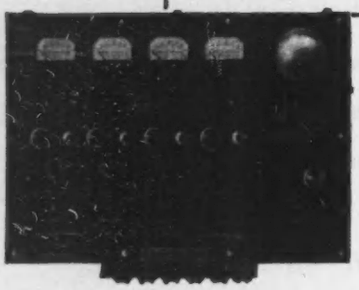


Mobil

MOBIL INDUSTRIAL LUBRICANTS

★ *Automatic Temperature Compensation ensures correct readings*

**A sure check on faulty feed water**



★ *Front panel is hinged for easy access*

THE **Crockatt** PATENT

**ELECTRIC SALINOMETER**

Impure Feed Water is the source of most boiler trouble. The Crockatt Salinometer registers all dissolved impurities on a 6" open scale and gives warning by both lamp and bell. The front panel hinges forward to give easy access to wiring. Full descriptive literature on request.

ALSO: *Feed Water Filters; Valve Reseaters; Boiler Tube Brushes; Floor Sanders; Terrazzo Surfacers, etc. Full lists on request.*

**W. CROCKATT & SONS LTD.**

64 DARNLEY STREET, GLASGOW, S.1

*Casting* **NO DOUBTS**

*Non-ferrous Foundrywork*

HEAVY, MEDIUM AND LIGHT SAND CASTINGS IN ALUMINIUM BRONZES MANGANESE BRONZES - NICKEL BRONZES - PHOSPHOR BRONZES - GUN METALS - ALUMINIUM, ETC. PATTERN MAKING AND MACHINING CHILL CAST SOLID AND CORED BARS

**J. T. Price & Co.**

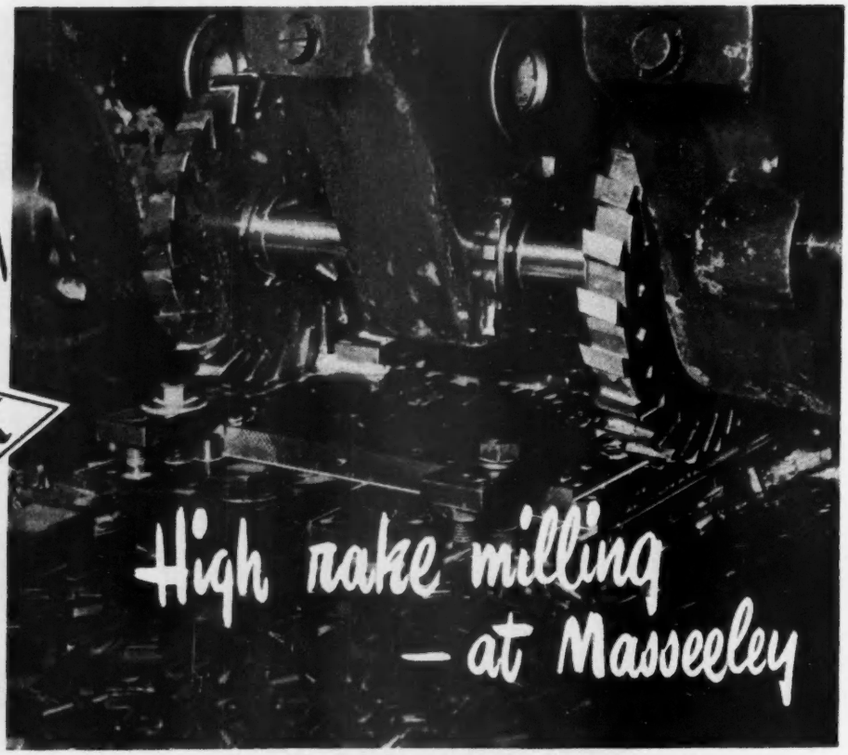
(BRASS & ALUMINIUM FOUNDERS) LTD.

NEWCASTLE STAFFS · phone 68011-2-3

Masson Seeley & Co. Ltd., of London, choose GALTONA for high rake milling at a feed rate of 20¼ inches per minute.
These steel platens are straddle milled with two 8" GALTONA O.K. High Rake Half Side Cutters, each with 22 high speed steel blades. The cutters have radial and axial rakes of 30° and 10° respectively and, running at 156 R.P.M. produce work to ±.001" limits.

Galtona TRADE MARK O-K

**SERRATED BLADE CUTTERS**




*Richard Lloyd Limited*

GALTON HOUSE, ELMFIELD AVENUE, TYBURN, BIRMINGHAM, 24

*Telephone: ASHfield 1801 Telegrams: "Cogs, Birmingham" Telex No. 33366*

C/4/2

LONDON AREA OFFICE: A. J. Percy, 240 Romford Road, Forest Gate, London, E.7. Phone: MARyland 2564

NORTHERN AREA OFFICE: A. V. Green, Britannia House, Wellington Street, Leeds, 1. Phone: Leeds 21212

NORTHERN IRELAND: Garage & Engineering Supplies Ltd. 78 Great Victoria Street, Belfast.

SCOTLAND: Stuart & Houston, 5 York Street, Glasgow C.2.

W.S.E. 22.

# Oil—BURNING QUESTION

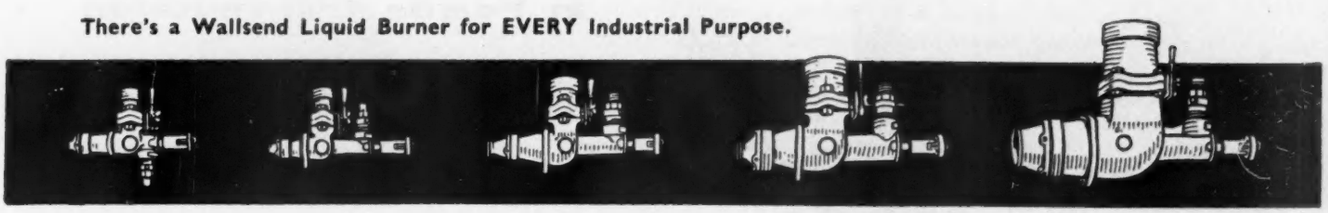
***The short answer is: Consult the***

**WALLSEND SLIPWAY AND ENGINEERING COMPANY LIMITED—**

*specialists of long experience in manufacturing and installing every type of Liquid Fuel Burner.*

Wallsend Liquid Fuel Burners are serving Industry in a diversity of ways. They are also installed in many famous buildings—grand hotels, concert halls, public buildings of all kinds and, as is well-known, Wallsend Fuel Burners are smoothly functioning in many of the famous ship that sail the seas of the world.

**There's a Wallsend Liquid Burner for EVERY Industrial Purpose.**



*For the detailed answer, write to :—*

THE WALLSEND SLIPWAY & ENGINEERING COMPANY LIMITED, WALLSEND-ON-TYNE.

HEAVY TRANSPORT

MARINE DIESELS

AIRCRAFT

MINING MACHINERY

EARTH MOVING

MACHINE TOOLS

# Think of the clutch

*" In . . . . . Out ! In . . . . . Out ! "*

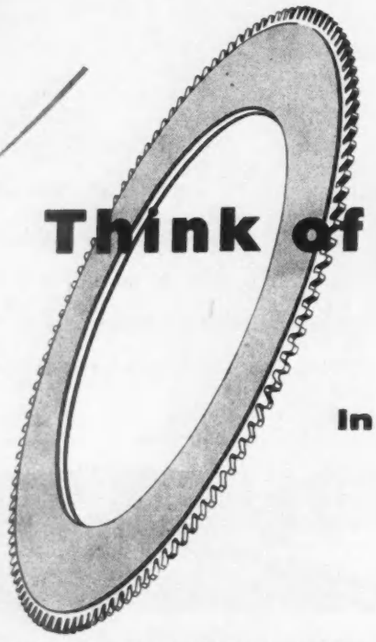
You can almost hear the Boat Race commentator's voice intoning the repetitive action that wears out the crews in some twenty minutes.

And so with clutch plates. The punishing friction inseparable from repeated engagements of the clutch inexorably wears out the normal type of clutch plate, with regrettable speed. Result—costly idle time for refacing or replacement.

But this is not so with SINTERLINK clutch plates. Faced with sintered metal of cellular structure, they stand up to a tremendous amount of friction for very much longer than conventional clutch plates. The exceptional resistance to wear of SINTERLINK and its remarkable ability to withstand and dissipate heat are the explanation.

***Any Answers?***

*We will gladly answer any questions either by correspondence or by personal call.*



**Think of MORGAN SINTERLINK**

**the final factor in Power Transmission**

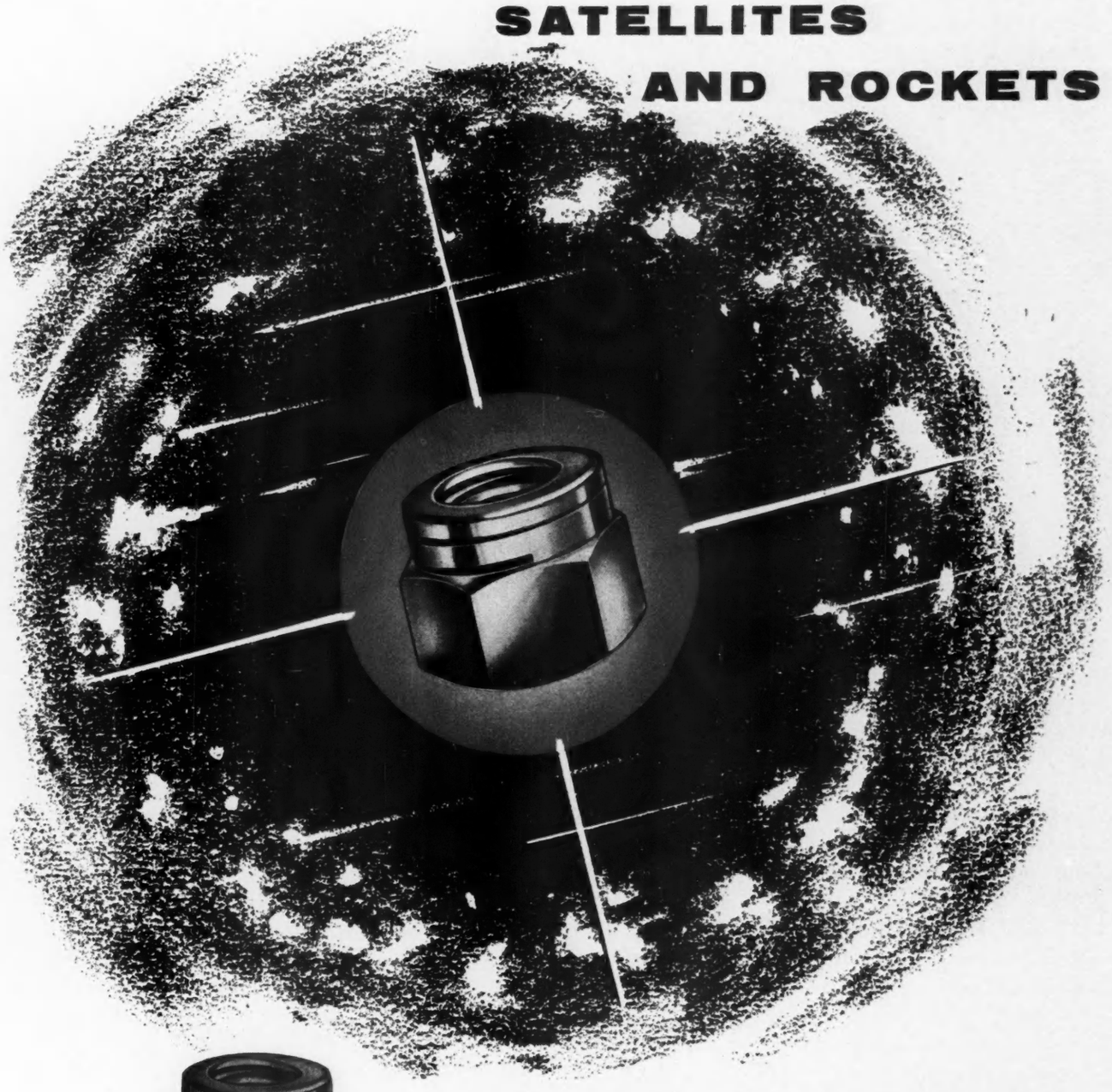
MAXIMUM MARKS TO SINTERLINK FOR

*Low Rate of Wear * Smooth Operation*
*Stability * Absence of Fade*
*High Thermal Conductivity*

THE MORGAN CRUCIBLE COMPANY LIMITED, BATTERSEA CHURCH ROAD, LONDON, S.W.11 Tel: BATTERSEA 8822

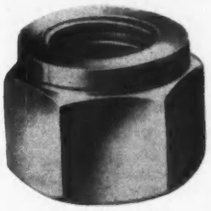
SM126/A

# IN ALL THE BEST SPACESHIPS SATELLITES AND ROCKETS



TURRET TYPE

## PHILIDAS
## SELF-LOCKING NUTS
## WILL BE USED



INDUSTRIAL TYPE

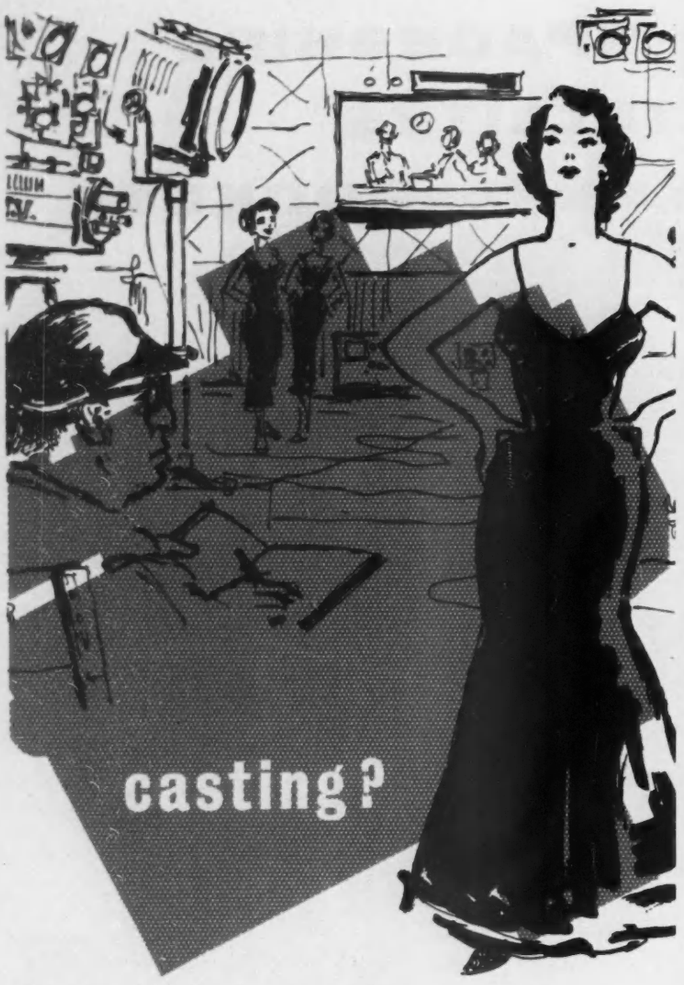
Potential conquerors of space take no risks in fitting Philidas self-locking nuts. Their ingenious opposing torque cross-cuts feature sets up a tension that only a spanner can release. Vibration, heat changes and oil infiltration leave Philidas nuts completely unmoved—and they can be used again and again. Range includes standard and thin industrial and turret nuts, turret wheel nuts, single and double anchor nuts.

**THEY YIELD ONLY TO A SPANNER**

*Send for our new catalogue*

**PHILIDAS DIVISION—WHITEHOUSE INDUSTRIES LTD**

*FERRYBRIDGE, KNOTTINGLEY, YORKS. TEL: KNOTTINGLEY 2323 (5 LINES). TELEX 55-166*
*LONDON OFFICE: 44 HERTFORD STREET, W.1. TEL: LEGATION 3888. TELEX 23549*




Not only casting, but precision-machining—and, if required, pattern-making, are covered by the FRANBER comprehensive service designed to cut production costs and time. And very many firms do find it cheaper, as well as quicker, to buy FRANBER finished parts to specification, and pass them straight to sub-assembly or assembly.

FRANBER offers complete, precision production for component parts, in aluminium, gunmetal, phosphor bronze, lead bronze, etc. (One speciality is gunmetal and phosphor bronze bushes in all sizes including graphite-filled self-lubricating types).

**This comprehensive service costs less than you expect —and the stickier production problems are welcomed! Have a word with our Technical Director at Cleckheaton 961.**

Franber

## FRANCIS W. BIRKETT & SONS LTD.

*Non-ferrous Founders and Engineers*

CLECKHEATON · YORKS · ENGLAND

Telephone: Cleckheaton 961/2/3

bir 10525

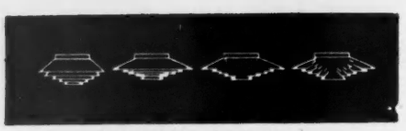
## THE FAIRITT SERIES

**Our range of Air Diffusers includes:**

**3**

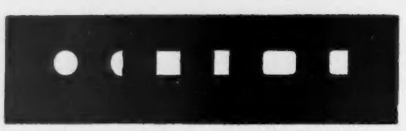
Main types, A, B and C.

**4**



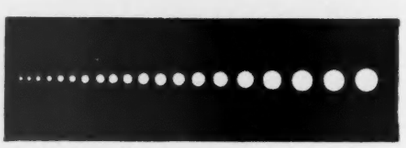
Variations, High level, Low level, etc.

**6**



Different Shapes, Round, Square, Rectangular and Half Round, Half Square, and Half Rectangular.

**20**



Different Sizes for most types, shapes and variations.

**making a range of more than**

**2000**

**different diffusers.**

In addition there are two kinds of dampers, and an airsplitter and damper available for most sizes, two kinds of metal are available and three different finishes for 300 different colours; and, what is more, we are constantly adding to this range.

*Send for Catalogue No. 21.*

## FAIRITT ENGINEERING CO. LTD.

AIRMASTER

101 Sandford Road, Moseley, Birmingham, 13
'Phone: South 3651

604 Grand Buildings, Trafalgar Square, London, W.C.2
'Phone: Whitehall 4805

# 100 MW turbo-generators nearing completion

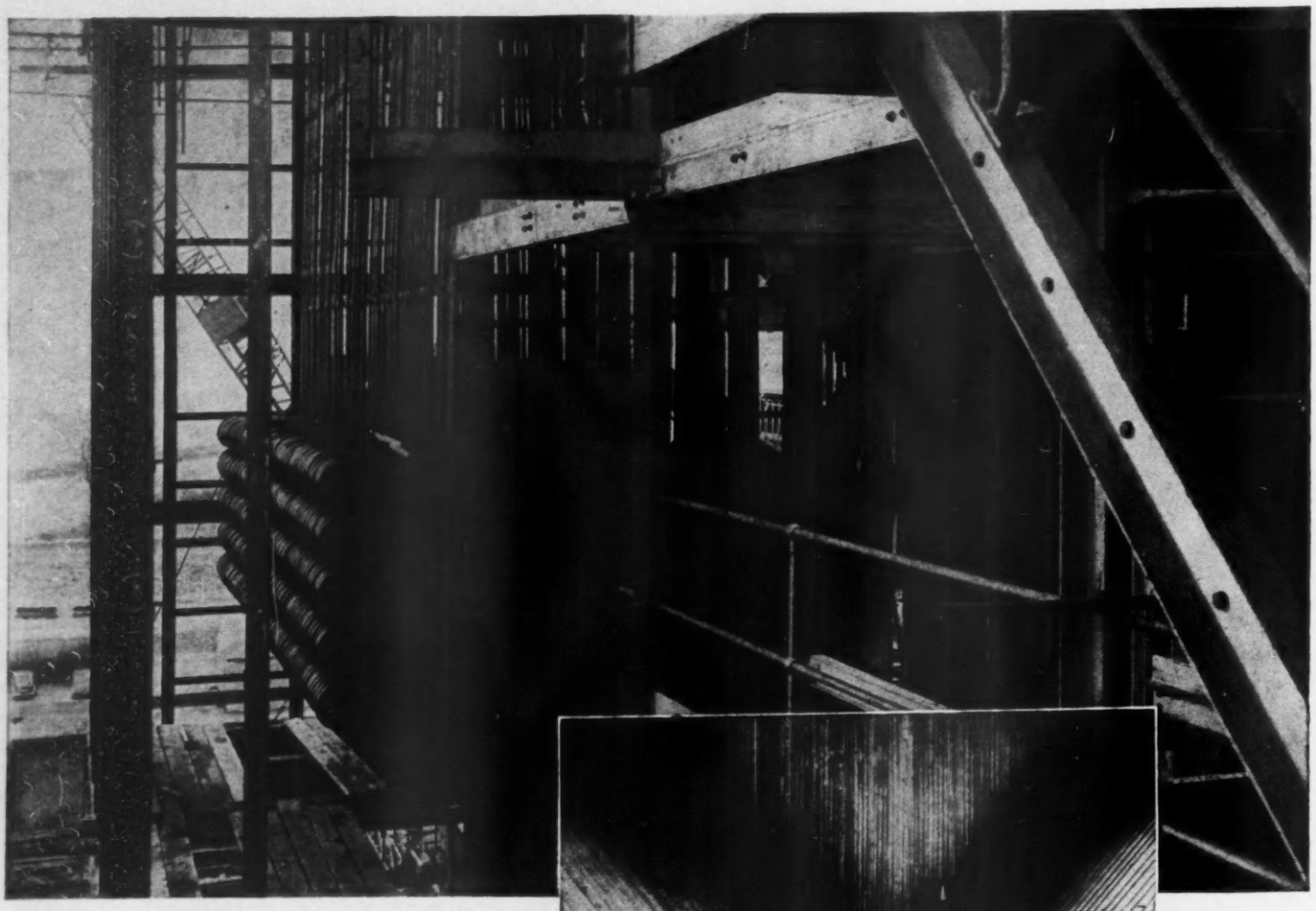
The installation of three PARSONS 100 MW turbo-generators is well under way at The Central Electricity Generating Board, Ferrybridge Power Station, Yorkshire. Here is the first machine nearing completion ; it is now in operation.

Steam conditions : 1500 lb/in² pressure,
975° F temperature
and reheat to 950° F.

PARSONS

**TURBO - GENERATORS**

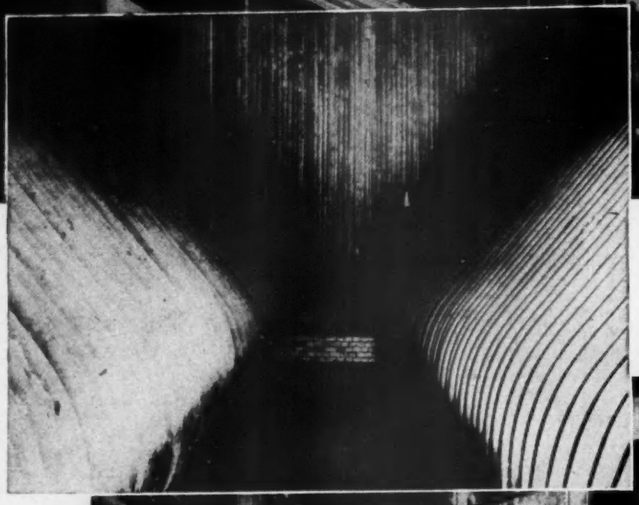
C. A. PARSONS & COMPANY LIMITED · HEATON WORKS · NEWCASTLE UPON TYNE 6

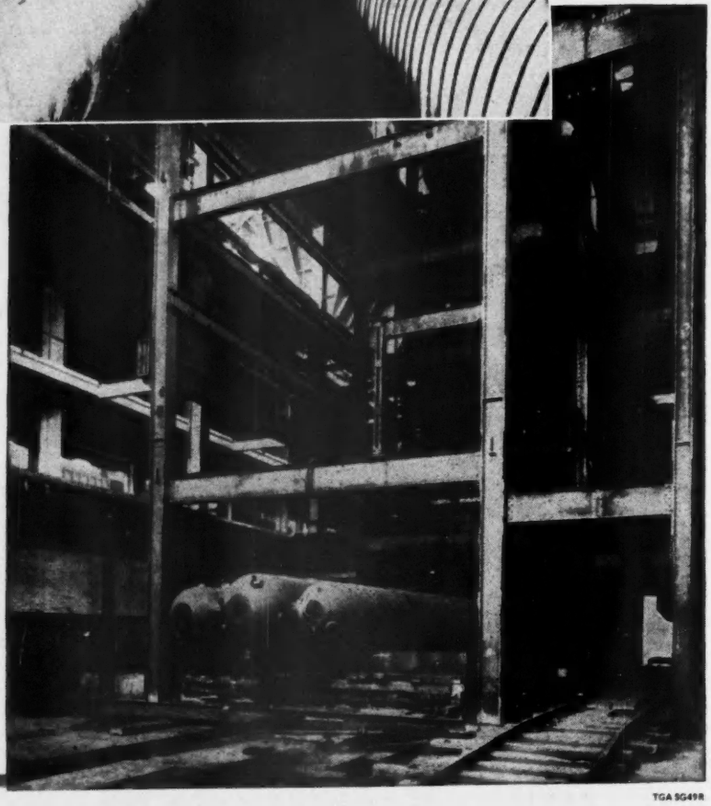


*Views of typical boiler installations.*

# Complete Steam Generation Plant

Maximum efficiency in Industry calls for maximum efficiency of steam generation plant. Vast experience in this sphere of engineering enables IC to design and construct outstanding plant either for the giant power station or the small boiler house.





**INTERNATIONAL COMBUSTION LIMITED**

London Office: Nineteen Woburn Place, W.C.1 Tel: Terminus 2833

Works: Derby, England

TGA 5G498

## NEW PRINCIPLE CUTS RUNNING COSTS TO A MINIMUM

# SESPA SELF-TENSIONING BELT-DRIVE

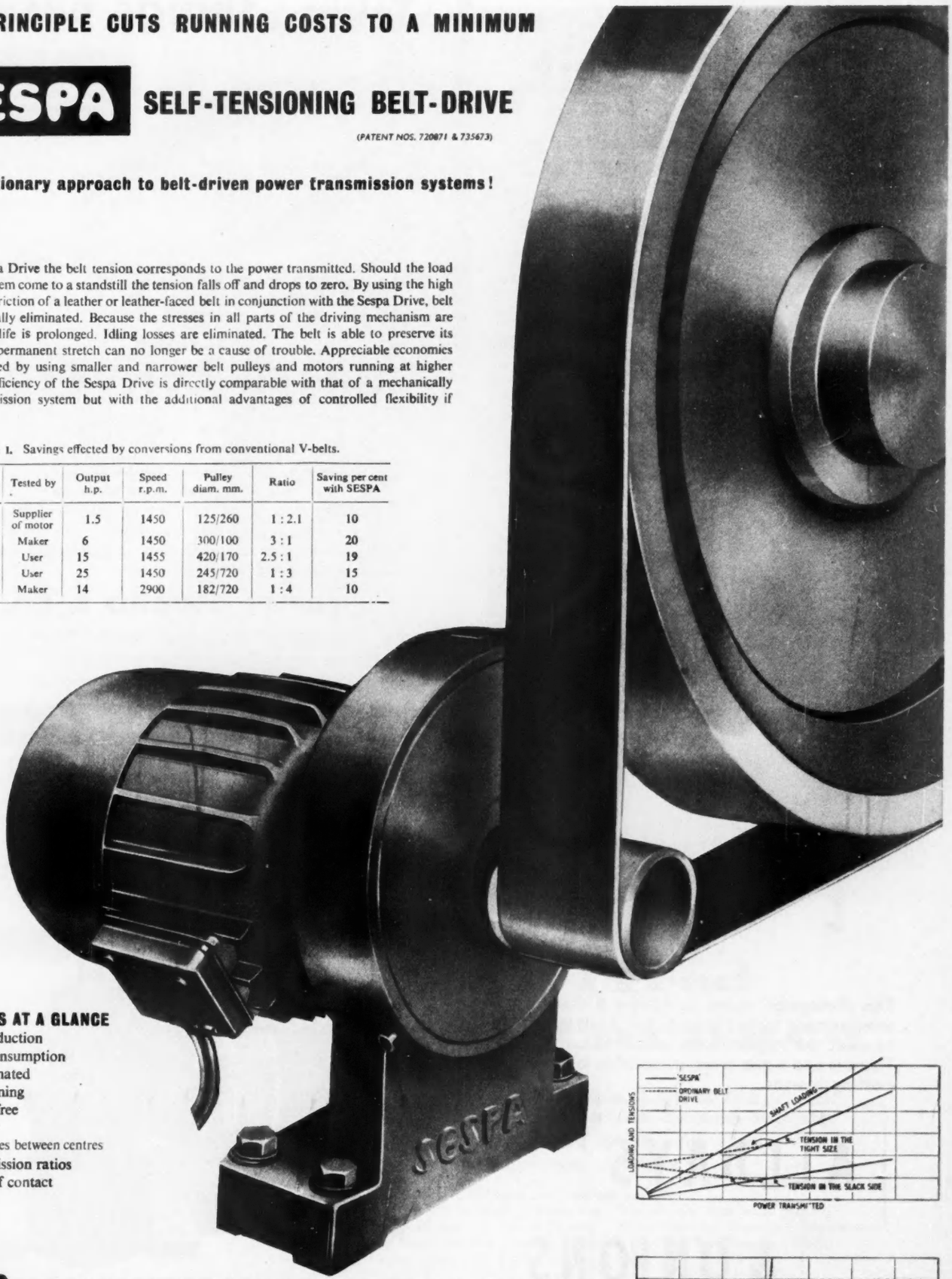
(PATENT NOS. 720871 & 735673)

**... revolutionary approach to belt-driven power transmission systems!**

With the Sespa Drive the belt tension corresponds to the power transmitted. Should the load fall or the system come to a standstill the tension falls off and drops to zero. By using the high coefficient of friction of a leather or leather-faced belt in conjunction with the Sespa Drive, belt slip is practically eliminated. Because the stresses in all parts of the driving mechanism are lowered their life is prolonged. Idling losses are eliminated. The belt is able to preserve its elasticity and permanent stretch can no longer be a cause of trouble. Appreciable economies can be obtained by using smaller and narrower belt pulleys and motors running at higher speeds. The efficiency of the Sespa Drive is directly comparable with that of a mechanically locked transmission system but with the additional advantages of controlled flexibility if required.

TABLE I. Savings effected by conversions from conventional V-belts.

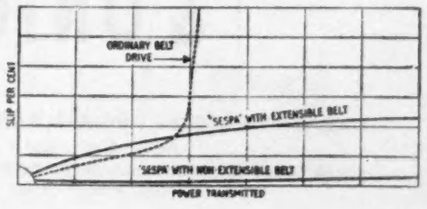
| Conditions Application | Tested by | Output h.p. | Speed r.p.m. | Pulley diam. mm. | Ratio | Saving per cent with SESPA |
|---|---|---|---|---|---|---|
| Loom | Supplier of motor | 1.5 | 1450 | 125/260 | 1 : 2.1 | 10 |
| Hammermill | Maker | 6 | 1450 | 300/100 | 3 : 1 | 20 |
| Fan | User | 15 | 1455 | 420/170 | 2.5 : 1 | 19 |
| Fan | User | 25 | 1450 | 245/720 | 1 : 3 | 15 |
| Compressor | Maker | 14 | 2900 | 182/720 | 1 : 4 | 10 |




**ADVANTAGES AT A GLANCE**

Increased production
Less power consumption
Belt slip eliminated
Smoother running
Maintenance free
Reduced wear
Shorter distances between centres
Larger transmission ratios
Small angles of contact




**SESPA can solve your most difficult problem of power transmission**

*WRITE NOW FOR FURTHER DETAILS TO*

**SESPA U.K. LIMITED, 243, Church Road, Mitcham, Surrey**

Telephone: Mitcham 1802 Telegrams: Sespa, Mitcham

# Dust & Grit Collectors

**A new addition to the range of A. & O. dust and grit collectors.**

This photograph shows an Alldays & Onions grit arrester hood applied to an A. & O. hearth designed to meet the requirements of the Clean Air Act. There is also a grit arrester available for fitting to existing hearths.

**ALLDAYS & ONIONS LTD**

**GREAT WESTERN WORKS, BIRMINGHAM 11.**
*Phone: VICtoria 2251-4*
**LONDON OFFICE: 2, QUEEN ANNE'S GATE, WESTMINSTER, LONDON S.W.1.**
*Phone: WHitehall 1923-4-5.*

# Taking things easy...

Metalrax Gravity Roller Conveyors ensure that the work runs smoothly, effortlessly. They take a load off your mind—as well as off the strength of your staff.

**METALRAX**

*Gravity*
## ROLLER CONVEYORS
*do the carrying*

The moderate cost of METALRAX Gravity ROLLER CONVEYORS is very soon repaid in time gained and labour saved. The wide use of these better-made conveyors by important organisations everywhere is proof of efficiency. Send for current list which gives full details of sizes and prices, straight sections, standard bends and adjustable stands.

**JAMES OSCARD & CO.**
Dpt. E. 139, WHITTON RD., TWICKENHAM. Tel. POPesgrove 5281

GUNMETAL BODY AND STUFFING BOX.

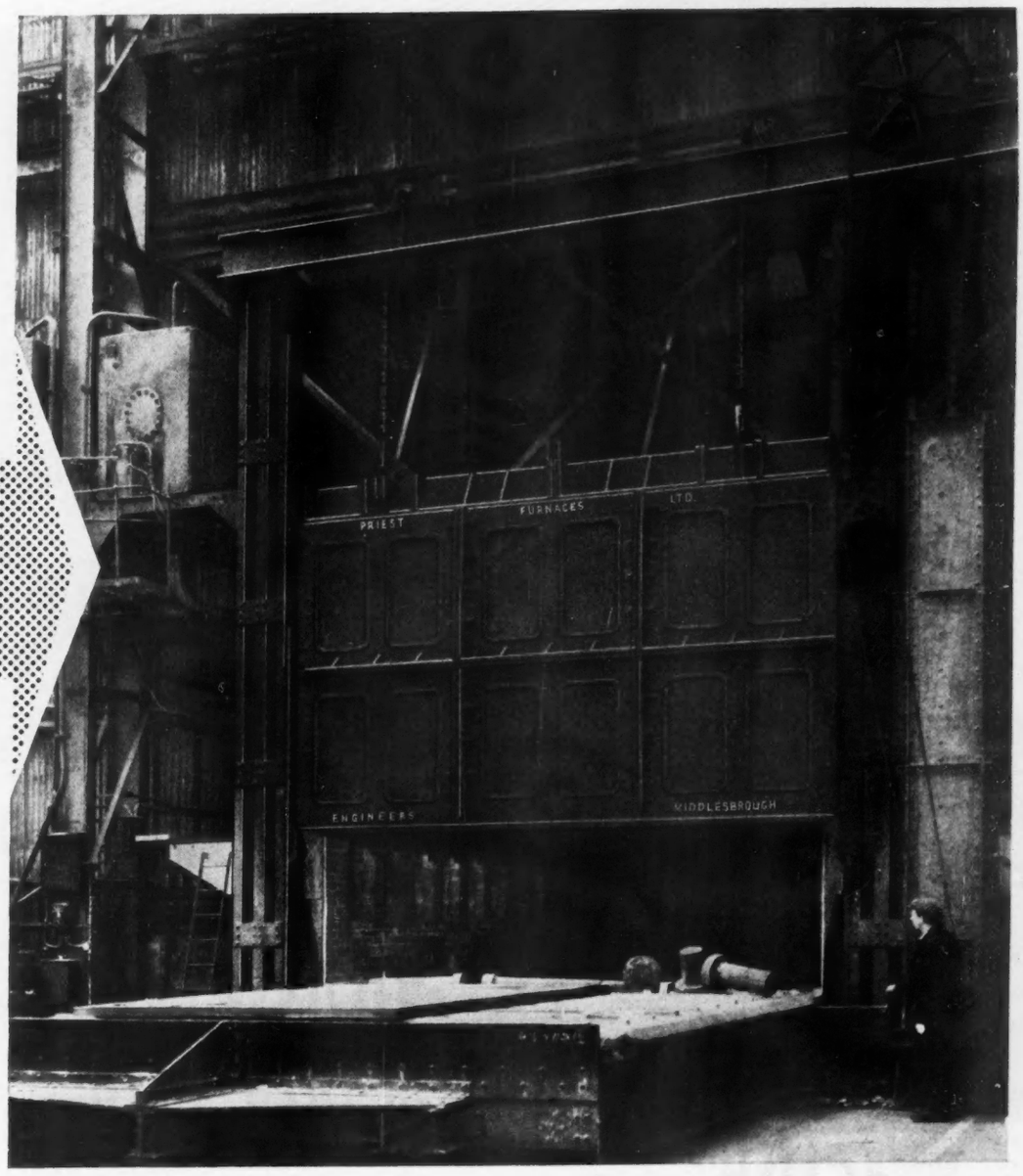
SCREWED — SQUARE THREAD ON SPINDLE.

HIGH-TENSILE MANGANESE BRONZE SPINDLE.

RENEWABLE DISC
# HYDRAULIC
STOP VALVE
FOR HIGH WORKING PRESSURES
LARGER SIZES CAN BE RE-PACKED UNDER PRESSURE

OR FLANGED.

**ROBERT HARLOW & SON, LTD.**
**HEATON NORRIS · STOCKPORT · CHESHIRE**
Telegrams: "HARLOW, STOCKPORT". Telephone No.: STOckport 3403/4/5
**LONDON OFFICE: 10 NORFOLK STREET, LONDON, W.C.2**
Telephone: COVent Garden 0315/6/7. Telegrams: "Tubenpipe"—"Phone-London"
3971




PRIEST

# Oil Fired Plate Furnace

Installed at the Clydebank Works of John Brown & Co. Ltd. Bogie hearth type Furnace, effective dimensions 20ft. long, 15ft. wide; maximum load 24 tons; this Furnace is also suitable for the heat treatment of steel drums.

*We specialise in the design and construction of:—*
Open Hearth Furnaces · Soaking Pits · Furnaces for Aluminium Melting, Coil Annealing and Slab Re-heating · Stress Relieving Furnaces · Forge and Heat Treatment Furnaces · Shipyard Plate and Bar Furnaces · Mould Drying Stoves · Modern Lime Burning Kilns

**PRIEST FURNACES LIMITED · LONGLANDS · MIDDLESBROUGH**
**also at TELEGRAPH BUILDINGS, HIGH STREET, SHEFFIELD.**

PRIEST
*The last word in Furnace design*

SPECIAL STEEL SECTIONS for ALL PURPOSES

TOLEDO
THE DARWINS GROUP

SHEFFIELD FORGE & ROLLING MILLS Co. LTD

TELEPHONE (5 lines) SHEFFIELD 24274

MILLSANDS · SHEFFIELD 3.

TELEGRAMS SHEFFORGE · SHEFFIELD

TELEX Nº 54-215

SFS.

....the world's best
HACK SAW BLADE

Made by James Neill & Co. (Sheffield) Ltd., and obtainable from all tool distributors

UB10

*A feature of post-war development is the remarkable expansion of the science of electronics in its application to industry, commerce and research . . .*

**Electronic Engineering**

**'ELECTRONIC ENGINEERING' brings to the reader every month instructive articles by leading authorities on the more important advances in electronics and news of their practical applications to industry: also descriptions of new instruments and equipment.**

•

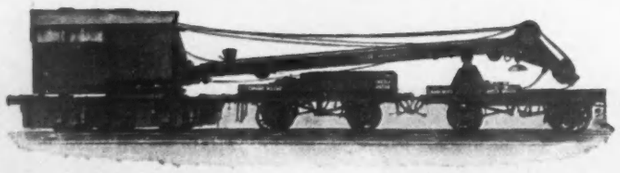
Price 3/-
Monthly

Subscription 36/- p.a.
or $5 (U.S. or Canada)

•

PUBLISHED BY
**MORGAN BROTHERS (Publishers) LIMITED**
(Proprietors of THE ENGINEER)
**28 ESSEX STREET, STRAND, LONDON, W.C.2.**

T&H FOR CRANES



10-ton Diesel Permanent Way Shunting Crane in train formation.

4-TON DIESEL SHUNTING CRANE, permanent way pattern, supplied to British Railways.

STEAM ELECTRIC DIESEL
DIESEL-ELECTRIC CRANES

10-ton Steam Permanent Way Crane, Metre Gauge. Duty: 10 tons at 16ft. radius propped; 5 tons at 14ft. radius free

TAYLOR & HUBBARD LTD. LEICESTER

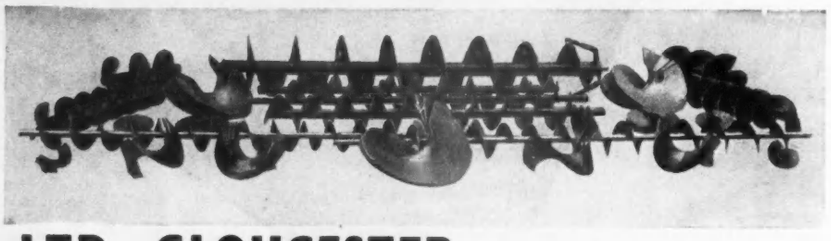
Telegraphic Address: "Lifting, Leicester" Telephone Nos.: 22575–6

P37

# BARRON SCREW CONVEYORS & ELEVATORS

**A complete range of Screw Conveyors. Standardised to facilitate installation and subsequent adaptation to plant requirements.**

Made in standard sizes from 4" diameter up to 20" diameter in any lengths up to 150ft. Either screw flights and shafts only for mounting in clients boxes or complete screw conveyors to our standard. Send for leaflet No. 110 giving full particulars of our standard screw conveyors giving full dimensions for planning to your layout. Clip-on covers ensure dust free operation with easy access for inspection.



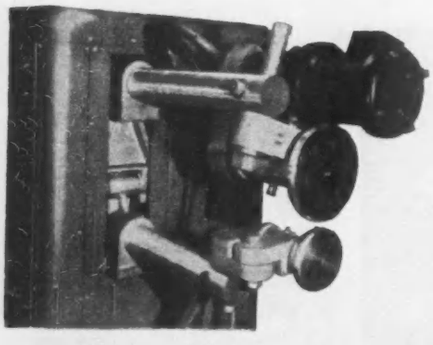
**W. S. BARRON & SON, LTD., GLOUCESTER.** Tele: Gloucester 21055/6/7 Grams: Barron Gloucester

MERITUS

# SEAM WELDING

## on MERITUS SPOT WELDING MACHINES

*all machines in our range are available for demonstration at our works at any time*



Models from **5-60 KVA** Pedal or Air Operated

**MACHINES FOR SPOT, STITCH, BUTT & SEAM WELDING**

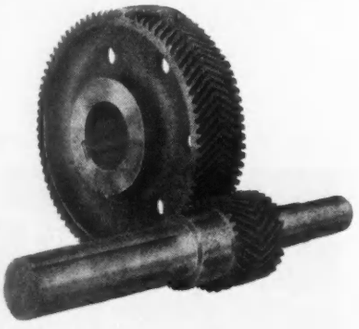
## MERITUS (BARNET) LTD.

**BARNET, HERTS.**

TELEPHONE: BARNET 2291/2

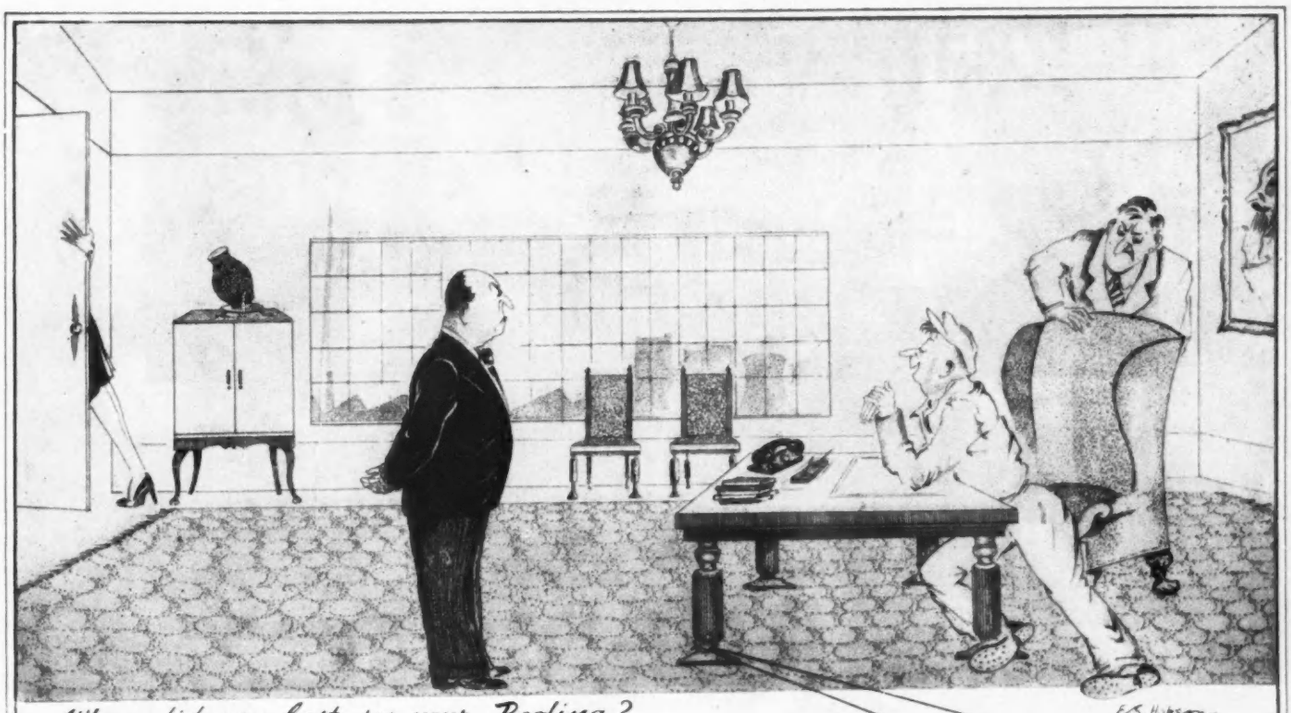
# BIRD'S

**DOUBLE HELICAL AND OTHER TYPES OF GEARS**



**W. H. BIRD & SONS LTD.**
**ST. PHILIPS, BRISTOL 2.**
'Phone: BRISTOL 77033.
Grams: Oiseau, Bristol.

# GEARS Bristol



*When did you last see your Roofing?*

Not for a moment would we think of suggesting
That YOUR roofs are urgently needing a testing,
But our object is that of a service most rare,
And that is a check-up of roof wear and tear.
T'is easy of course for a maintenance man
To perhaps overlook - apart from a 'scan'
Depreciations - the wages of time,
Damages, breakages, leakages, grime.
Our plans for a periodical 'look'
Would take care of this for you - gratis to boot.
Roofing and glazing for natural light
Is a job we are used to, and think have the right
To claim expert knowledge and experience wide.
To discover all faults which frequently hide
Causes of damage to goods and production,
Efficiency, daylight and costs reduction.
The future advantage to you is 'no worry'.
We are prepared to perform in a hurry,
Any re-roofing, re-glazing, repairs,
Which are urgently needed to dispose of your cares.
Our long and tried service is at your disposal
Craftsmen and Draughtsmen will offer proposal
For immediate counter to a roof near redundant.
Practical knowledge and schemes quite abundant.
The foregoing rhyming is not very good
But our workmanship is, and we would if we could,
Offer to you with, we hope, not persistence,
Our best possible service, help and assistance.

* *

If you have a need for immediate action,
Wire, ring or write, and get satisfaction
From departments E.H., G.T.N., or T.B.
The results will astonish you, we'll guarantee.

E.S.H.

HEYWOODS
OF HUDDERSFIELD

*FOR EFFICIENT PATENT ROOF GLAZING AND STRUCTURAL THERMAL INSULATION DOUBLE GLAZING. LANTERN LIGHTS. WALKWAYS ETC., AND ALL ROOFING PROBLEMS*

**W. H. HEYWOOD & CO. LTD., HUDDERSFIELD. Tel. 6594 (5 lines)**

*Branches at: London, Manchester, Glasgow, Belfast, Newcastle, Birmingham, Liverpool, Leicester, Nottingham, Bristol.*
*Associate Company in Eire: W. H. Heywood & Co. (Ireland) Ltd., 63-64 Upper O'Connell Street, Dublin.*

**R. H. Campbell**
*SALES DIRECTOR*
*STOCKPORT*

**Bob Holland**
*BIRMINGHAM*

**Bill Budd**
*MONTREAL*

**Worldwide**

You may know some of the men who sell WHARTON cranes. But you won't know the men who actually build them. And that's a pity.

We know them. We know the excellence of their work, the skill and experience which they use to such good—and lasting—effect.

Eric Ward, for instance. He began learning about WHARTON cranes when he joined our machine shop 39 years ago, to be followed 25 years later by his son Donald.

"It's the sort of place," says Eric, "where you can put your heart into the job and know that people appreciate your work. And there's always plenty of it. I've been on overtime since 1927."

It's natural that the Wards and others like them are busy. Because people DO appreciate cranes built by such craftsmen . . . WHARTON cranes.

**THE WHARTON CRANE & HOIST CO. LTD.**

**REDDISH STOCKPORT ENGLAND**

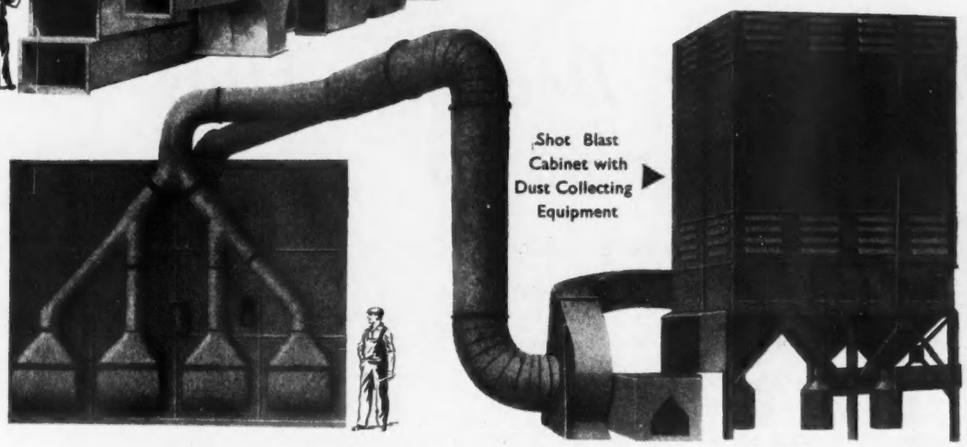
Phone: Heaton Moor 2227. Grams: "Gallant, Manchester." Code: Western Union

| | | |
|---|---|---|
| LONDON : Lincoln House, 296/302 High Holborn W.C. 1. | Phone : Chancery 7911. | Grams : Chancery 7911. |
| SCOTLAND : Fisher-Baxter & Co., 140 West George Street, Glasgow C. 2. | Phone : Douglas 1061-2-3. | Grams : Fluorspar, Glasgow. |
| MIDLANDS : A. R. Holland & Son, 89 Cornwall Street, Birmingham 3. | Phone : Central 1457. | Grams : Central 1457, Birmingham. |
| SOUTH-WEST : R. C. Collins, 48 Westbourne Road, Penarth, Glamorgan. | Phone : Penarth 1527. | Grams : Penarth 1527. |
| NORTHERN COUNTIES : Fisher-Baxter & Co., 140 West George Street, Glasgow C. 2. | Phone : Douglas 1061-2-3. | Grams : Fluorspar, Glasgow. |
| NORTHERN IRELAND : General Engineering Products Ltd., 7/9 Great Patrick Street, Belfast. | Phone : Belfast 23743. | Grams : Belfast 23743. |
| EIRE or SOUTHERN IRELAND : Charles Nolan & Co., 2 Parker Hill, Lower Rathmines Road, Dublin. | Phone : Dublin 93510. | Grams : Dublin 93510. |
| CANADA : Marshall Equipment Co. Inc., P.O. Box 28, 61 Victoria Avenue, Dorval Station, P.Q. | Phone : Melrose 1-3578. | Grams : Marquipco, Montreal. |

**REPRESENTED IN PRINCIPAL COUNTRIES THROUGHOUT THE WORLD.**

# VENTILATING and DUCTING EQUIPMENT

Illustration shows a portion of a large ventilation scheme recently installed for the United Kingdom Atomic Energy Authority. We have a fine staff of experienced engineers capable of designing plants for most industrial requirements. Our Technical Director will be pleased to give you personal service.

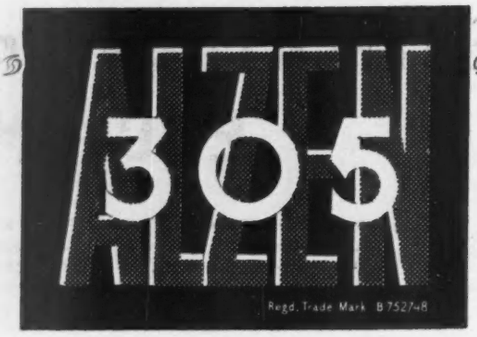


Shot Blast Cabinet with Dust Collecting Equipment

- PNEUMATIC CONVEYORS
- MULTICELL FILTERS FOR GRIT ARRESTING PLANTS
- EXISTING POWER STATION PLANT MODERNISED & REPAIRED
- WET SETTLERS SUPPLIED FOR FOUNDRIES, BRICK & TILE WORKS, GAS CLEANING ETC.
- AIR WASHERS & FUME SCRUBBING TOWERS DESIGNED & INSTALLED
- FOG ELIMINATING PLANT

**BATES BROTHERS (ENGINEERS) LTD.** WYTHENSHAWE, MANCHESTER 23

TELEPHONE: WYTHENSHAWE 3411 (5 LINES)




# *White Bronze Bearing Alloy*

BRIT. PAT. 725818

## ENTERS ITS SECOND YEAR

Alzen 305 is now just over one year old. In that short time it has made a great impact upon engineers in many trades in Great Britain.

The proof of the claims made for it has been so abundant and conclusive that a great future for Alzen 305 is a foregone conclusion.

It remains, however, for a great many more of Great Britain's leading engineers in many industries to make their own assessment of the outstanding qualities of Alzen 305 in their own laboratories, and to be convinced of its great value to them.

May we again urge them to do this. We will co-operate in every way possible.

The qualities of Alzen 305 White Bronze Bearing Alloy which no one can afford to ignore are:

**HALVES THE BEARING WEIGHT**
**SAVES 40% OF ITS COST**
**LENGTHENS ITS LIFE**

Alzen 305 is available in the following forms—ingot, Sand, Gravity Die, Shell Moulded and Pressure Die Castings, Chill Cast Bars, cored and solid.

***May we send technical literature and samples for testing ?***

P.O. Box 22, Stringes Lane, Willenhall, Staffs. Telephone: Willenhall 227 (5 lines) Telegrams: Hill, Alzen 227 Willenhall

WhiteAd 3934

# L.E.H.
## Hydraulic VICING RAMS

This heavy duty vicing ram is another example of the wide range of special purpose hydraulic equipment which L. E. H. manufacture to customers' requirements.

*If your problems include presses, pumps, valves, rams or other hydraulic equipment the experience and resources of L. E. H. will gladly be placed at your disposal.*

LEH

DESIGNERS AND MANUFACTURERS OF HYDRAULIC EQUIPMENT

THE LEEDS ENGINEERING & HYDRAULIC CO. LTD.
RODLEY · LEEDS · Telephone: Pudsey 2859

?
## *Tackling the need for greater productivity*
?

MODEL NO. 2/DEC. £6 : 17 : 6 AND £8

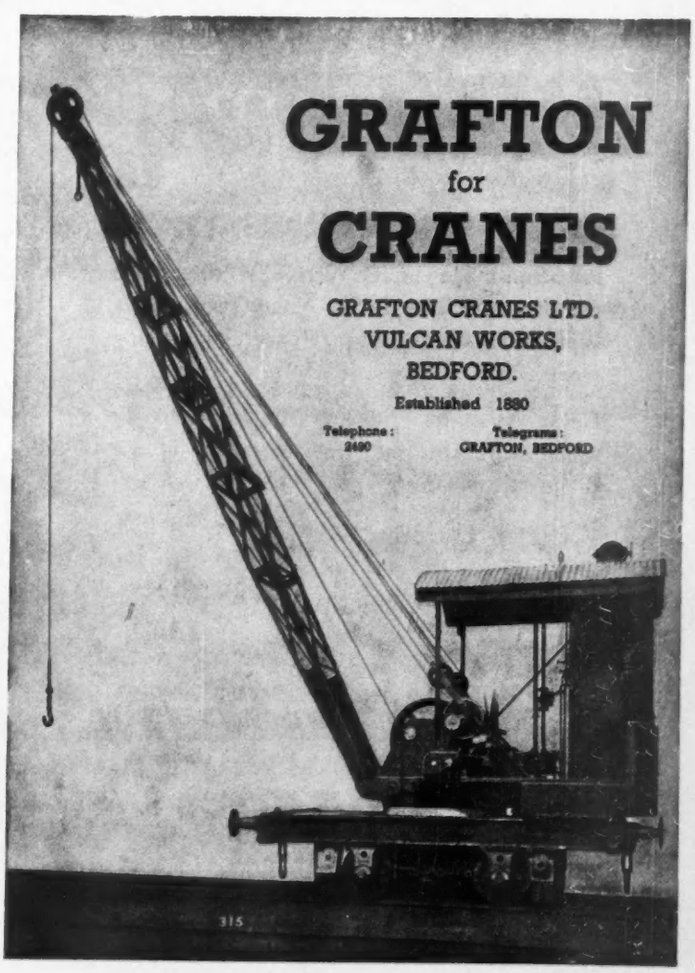
MODEL NO. 2/1/5 £6 : 17 : 6 AND £8

MODEL NO. 2/DEC/1/5 £8 : 5 : 0

Greater productivity is more than ever a national necessity. Prestons Ltd. — the largest suppliers of Stop-Watches to British Industry—can help by supplying "work-study" specialists with Swiss Timers—the finest quality jewelled lever Stop-Watches available, giving long and accurate service.

**PRESTONS LTD.**
● *INDUSTRY'S LARGEST STOP-WATCH SUPPLIERS*
BOLTON — LANCS — TEL: 876/7

**SWISS TIMERS**
SEND FOR OUR Illustrated Catalogue and Price List.

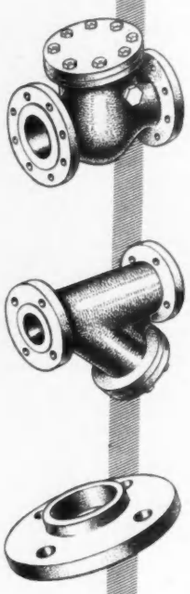


# Vanguard

**Vanguard valves and pipeline fittings, specially designed and manufactured for the oil, petro-chemical, atomic energy, pharmaceutical, and related industries.**

*The range available includes :—*

- Stop, Swing Check Valves, 'Y' Pipeline Strainers in Cast Carbon Steel, trimmed to requirements.
- Wedge Gate, Stop, Swing Check Valves, 'Y' Pipeline Strainers, Flanges, Elbows, Tees, Unions, Pipeline Fittings, in Stainless Steel.
- Tees, Elbows, Crosses, Unions, etc., in Forged Carbon Steel.



All valves and fittings conform to the latest British and American Specifications.

*First in the Line*

*Write for illustrated literature to Dept. E.*

**THE VANGUARD VALVE COMPANY LIMITED**
**Triplex Works · Eastern Avenue · Gloucester**
Tel. : Gloucester 26211



MAKE LIGHT OF THAT

# Heavy Duty

## Equip with KING DICK

Precision-made under carefully controlled conditions, KING DICK Hand Tools set a superlative standard for Heavy Engineering work.

*Please send for fully illustrated catalogue which will give you complete details of our range of hand tools.*

BUY KING DICK BRITISH

ABINGDON KING DICK

**HAND TOOLS**

**ABINGDON WORKS · KINGS ROAD**
**TYSELEY · BIRMINGHAM, 11**

**HEAVY DUTY RING SPANNERS**
A formidable tool when used in conjunction with our special tubular handles.

**OPEN ENDED PODGER SPANNERS**
In B.S., B.S.W., American, A/F and Unified Hex. Sizes.

**SLOGGING RING SPANNERS**
Available in B.S., Whitworth, American, A/F, and Unified Hex. Sizes to suit all requirements.

**FLAT 7½° SLOGGING RING SPANNER**
In B.S., B.S.W., American, A/F and Unified Hex. Sizes.

**PODGER ENDED SOLID BOX SPANNERS**
In B.S., B.S.W., American, A/F and Unified Hex. Sizes.

**RING PODGER SPANNERS**
A heavy-duty tool supplied in all sizes to meet your requirements.

**DOUBLE OFF-SET RING SPANNERS**
Forged in Chrome Vanadium Steel to withstand the hardest work.

**POWER OPERATED SOCKETS**
For assembly lines, heavy engineering and Hicycle Tools. In ⅜", ½", ¾", 1", 1½" and 2½" Square Drive.

RE 200

# Stop Burning One in Ten!

**Have a look at your power bill — and then consider your plant. Are you *sure* you are getting the most out of your transmission — or are inefficient drives frittering away the kilowatts which should be helping production?**

**As power costs increase efficiency matters more than ever — fit the only drive with a National Physical Laboratory Certificate confirming 98½% mechanical efficiency and get the power you pay for.**

## RENOLD high-efficiency drives cut your overheads

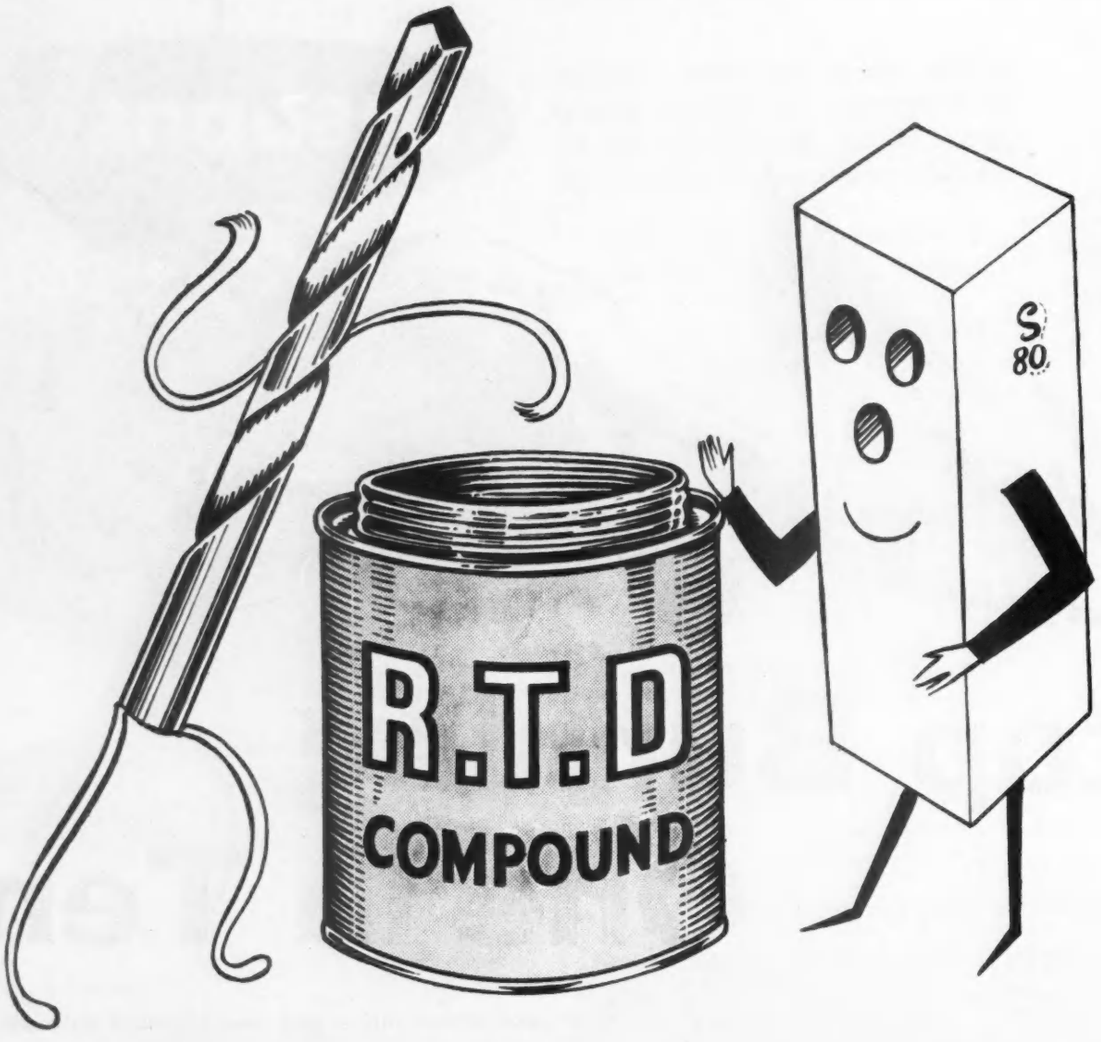
. . . Since 1947 electricity charges have almost doubled.
. . . Look at these figures from a typical factory :—

1947 £2·925 per 1,000 Units
1957 £4·9 per 1,000 Units

By making the most efficient use of power RENOLD CHAIN DRIVES are an effective counter to this cost spiral and can offset these and any future increases by as much as 10% — and go on doing so year after year.

RENOLD —*the FIRST name in precision chain*

RENOLD CHAINS LIMITED · MANCHESTER




# "Between you and me" (SAID THE DRILL)

# "I like a spot of R.T.D."

"Me too," said Stainless (with a steely glance), "especially when I'm under pressure".

"*It does avoid a lot of friction*", *agreed the Drill.* "*D'you know, the other day I almost had a seizure* !"

"Drills run free with R.T.D.", said Stainless, "and don't you forget it makes things smoother for the likes of us, as well".

"*Just the stuff when the drilling's tough*", *replied the Drill.* "*And saves me growing old before my time* !"

**ROCOL R.T.D. COMPOUND** does indeed prolong the life of drills (in fact, *all* cutting tools) many times over, and obtains a higher finish. Lubricate with R.T.D. when working with tough metals, including stainless steel, alloy steels and nickel alloys. Write for the Brochure, giving technical information and over 20 actual case histories.

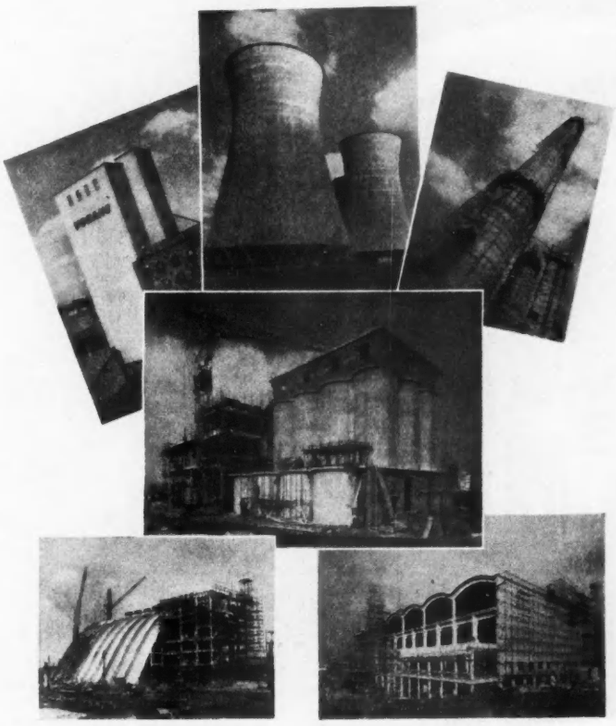
*Write to ROCOL about R.T.D.*

ROCOL LTD · IBEX HOUSE · MINORIES · LONDON E.C.3 · *Telephone ROYal 4372*

ROCOL HOUSE · SWILLINGTON · Nr. LEEDS · *Telephone Garforth 2261/2*

A Rocol PRODUCT

ndh 3273



# REINFORCED CONCRETE

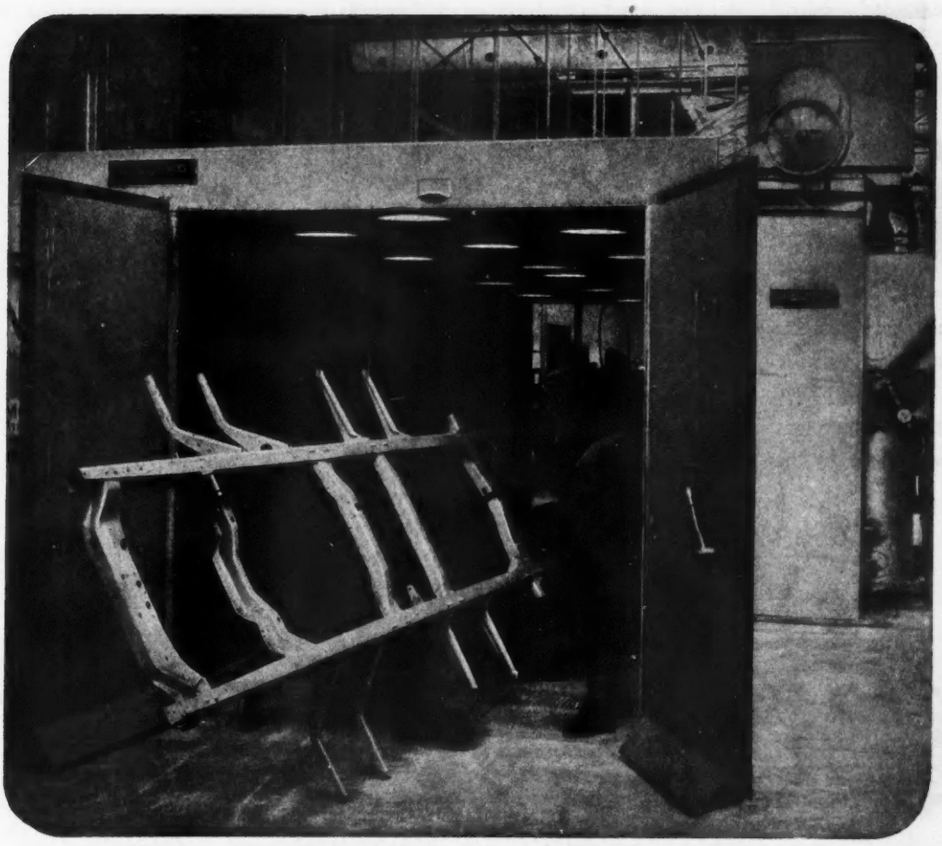
Do any of these structures interest you ?
Why not get in touch with Holst & Co.
who specialise in Design and Construction.

DESIGN & CONSTRUCTION BY

**HOLST**
& CO LTD
Civil Engineering Contractors, Reinforced Concrete

Head Office : 46 CLARENDON ROAD, WATFORD, HERTS. Telephone : GADebrook 4481

BRANCHES : BIRMINGHAM · MANCHESTER · LEEDS · DURHAM · EDINBURGH · CARDIFF



# SHOT BLAST ROOM PLANTS

OVER 50 YEARS' EXPERIENCE EMBODIED IN OUR WORK

ALL TYPES OF WHEEL
OR COMPRESSED AIR PLANTS

TURNTABLES · CABINETS · BARRELS

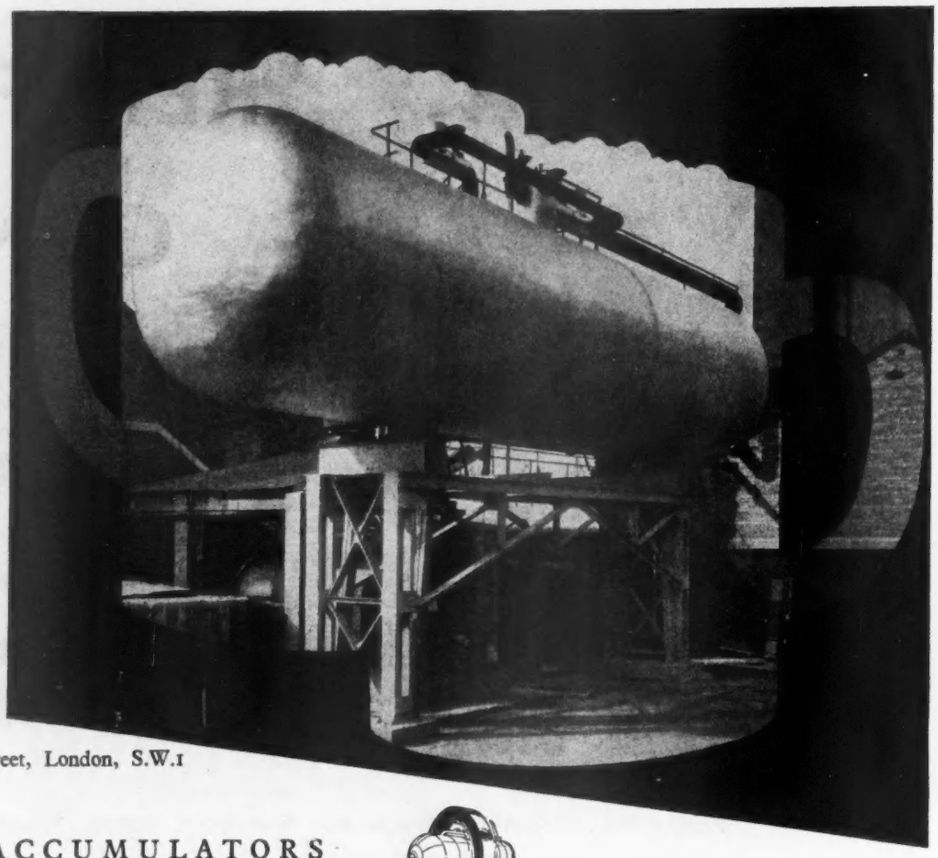
SHOT AND GRIT

*Buy British*

**ST. GEORGES ENGINEERS LTD., ORDSALL LANE, TRAFFORD BRIDGE, MANCHESTER, 5.**

*Telephone: Trafford Park 1207 (4 lines) Telegrams: "Georgic," Manchester*

# *Steam storage in a brewery*



A Ruths Steam Storage Accumulator takes care of the fluctuating steam demands at the Wellpark Brewery of Messrs. J. & R. Tennent Ltd., Glasgow.

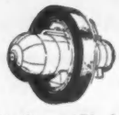
The shell is 11′ 0″ in diameter and 50′ 0″ long. The accumulator works over a pressure range of 150 to 70 p.s.i. giving a reserve of 11,250 lbs. of steam which is instantaneously available to meet all process demands in excess of *steady* boiler output.

Steam users in **all** industries can overcome problems arising from peak steam demands by installing Ruths Steam Accumulators. Please consult:—

COCHRAN & CO., ANNAN, LTD., Annan, Dumfriesshire, Scotland, and at 34 Victoria Street, London, S.W.1

RUTHS Regd Trade Mark

STEAM ACCUMULATORS

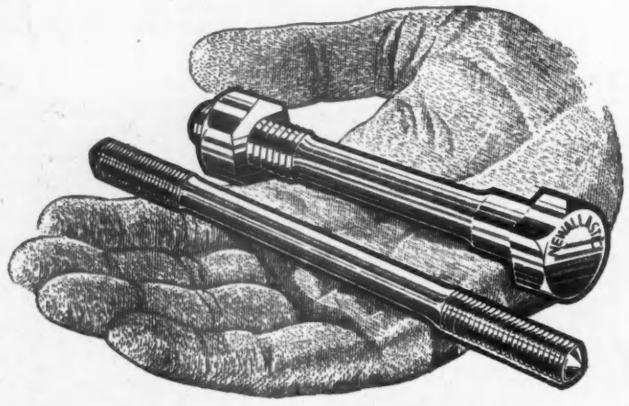


*The Thermal Flywheel*

TAS/CH.609

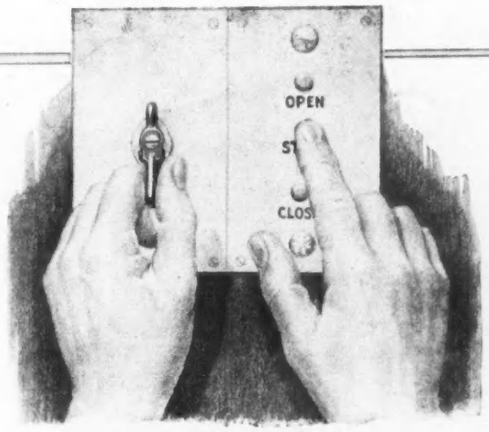
# Unique

"Newallastic" bolts and studs have qualities which are absolutely unique. They have been tested by every known device, and have been proved to be stronger and more resistant to fatique than bolts or studs made by the usual method.




# C. P. Newall & Co., Ltd.

POSSILPARK · GLASGOW · N.




# POWER OPERATED

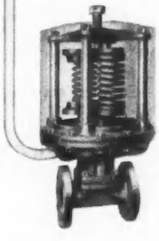
## SAUNDERS DIAPHRAGM VALVES

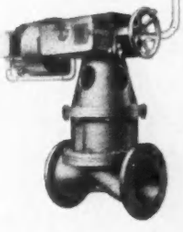
DIAPHRAGM OPERATED
PRESSURE CLOSING

DIAPHRAGM OPERATED
PRESSURE OPENING

PISTON OPERATED

DIRECT ELECTRICALLY
OPERATED





SAUNDERS VALVE COMPANY LIMITED

DIAPHRAGM VALVE DIVISION

CWMBRAN · NEWPORT · MONMOUTHSHIRE

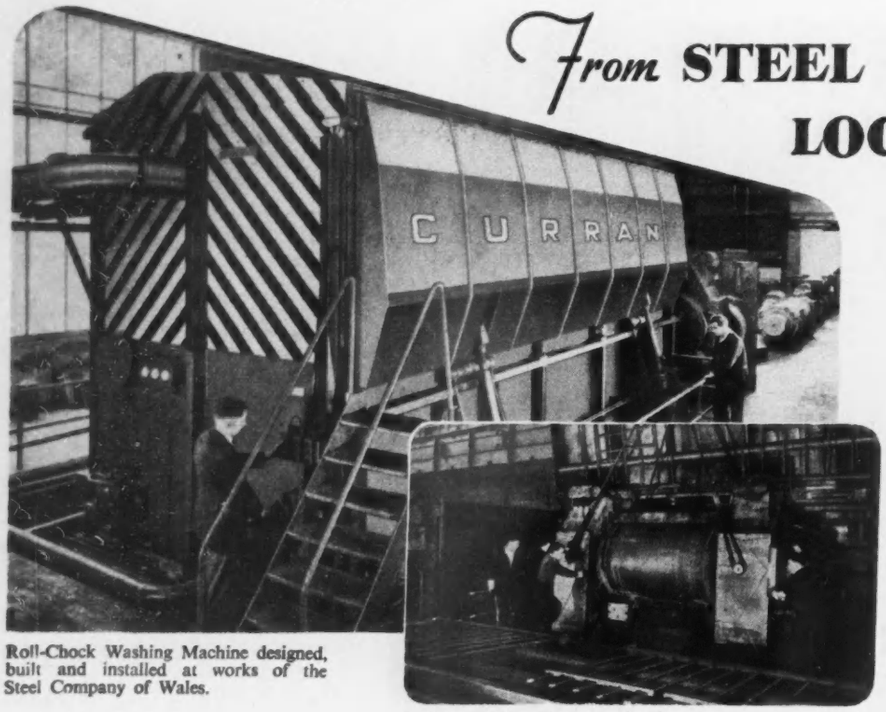
Telephone: CWMBRAN 3081-7

LONDON
23, Palace Street, S.W.1
Telephone TATe Gallery 8687

LEEDS
Kildare Place
Telephone Leeds 21388

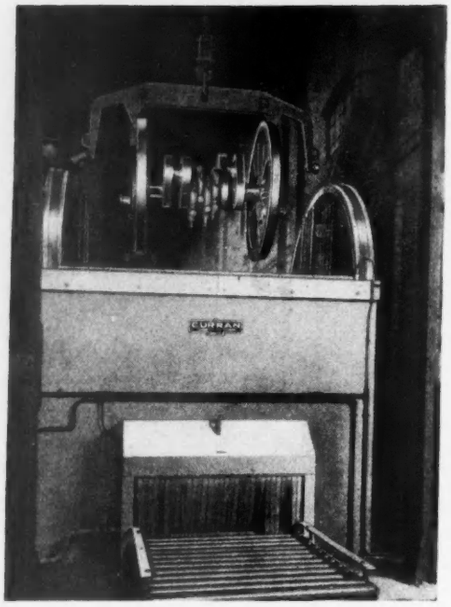
GLASGOW
29a, North Frederick Street, C1
Telephone Douglas 1139

# *From* STEEL ROLL-CHOCKS *and* LOCOMOTIVE WHEELS to the smallest CLOCK PARTS




Roll-Chock Washing Machine designed, built and installed at works of the Steel Company of Wales.

Roll-Chock in position for cleaning.



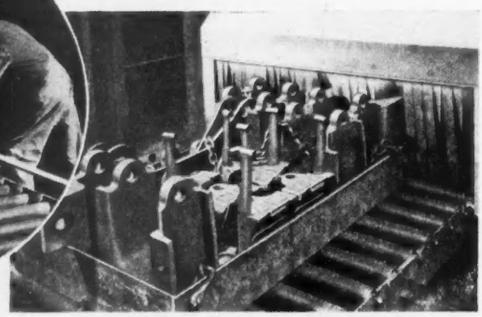

Locomotive Wheel and Components Cleaning Machine installed at Caerphilly for Ministry of Transport.

## *... thoroughly cleaned with the*

**CURRAN DEGREASING · PICKLING AND WASHING MACHINES**

Not only in Great Britain, but in practically every country in the world, these CURRAN MACHINES are speeding production. Each plant is specially designed to conform to the manufacturers' particular requirements. Every Curran Machine bears the Hall-Mark of thirty years' experience in metal cleaning.

Placing components in Machine for cleaning.

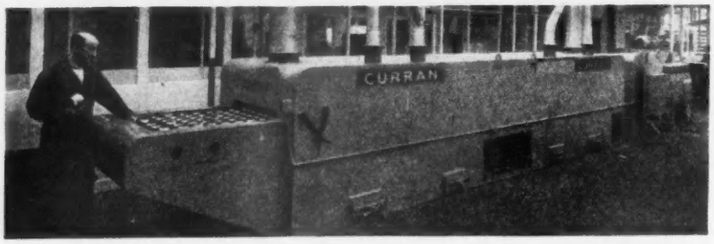


Components emerging thoroughly cleaned.

**THE CURRAN SERVICE**

A unique feature of the Curran Service is the supply of pretreatment compounds including Paint Strippers, Metal Surface Conditioners, Dewatering Oils, Detergents, etc. Thus equipment and compounds are available for all industrial cleaning. In addition, a technical staff are always ready to help and advise.

***Write today for complete catalogue***



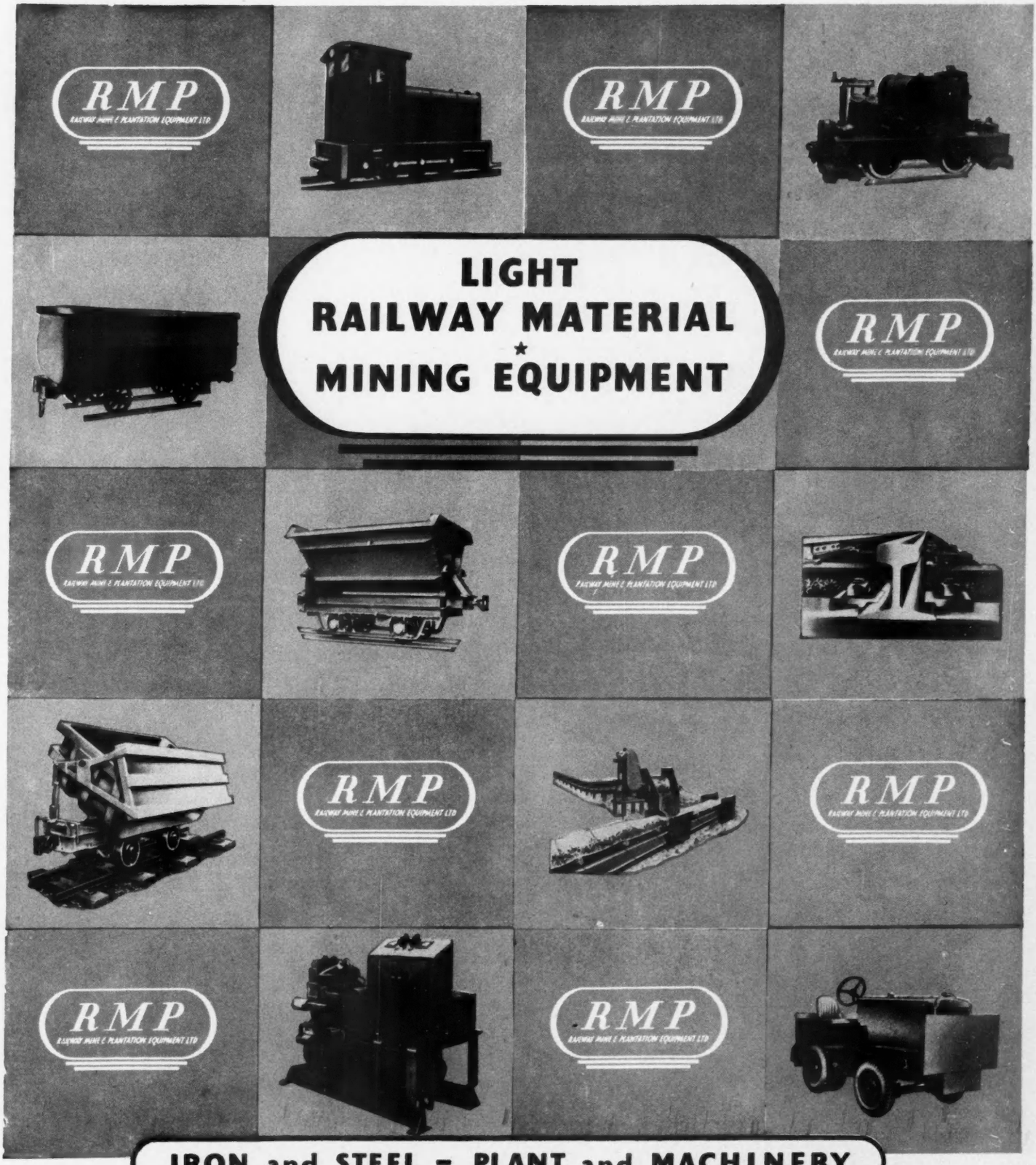

Degreasing · Rinsing · Chromating and drying clock parts for Westclox Ltd.

**EDWARD CURRAN ENGINEERING LTD** PROCESS PLANT DIVISION **CARDIFF**

TELEPHONE CARDIFF 33644

MANUFACTURERS OF DEGREASING & SPRAY PICKLING PLANTS FOR ALL PURPOSES

PP.19



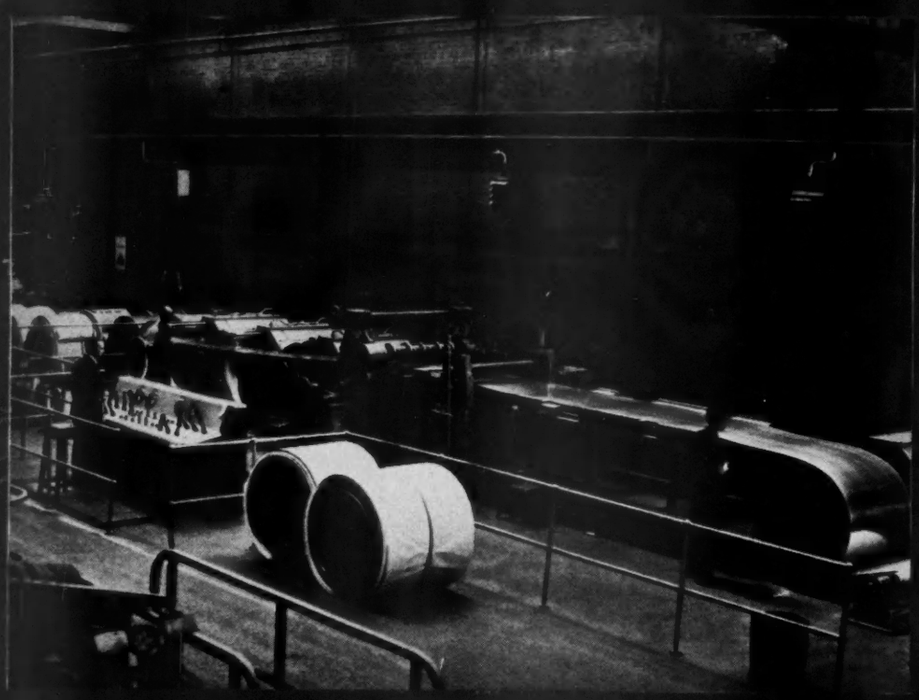

IRON and STEEL – PLANT and MACHINERY

**RAILWAY MINE & PLANTATION EQUIPMENT LTD.**

IMPERIAL HOUSE · DOMINION STREET · LONDON E.C.2.

Telephone: MONarch 7000 (20 lines) · Grams: Minplan Ave. London. · Cables: Minplan London.

# Keelavite HYDRAULICS



THE RECOGNISED AUTHORITY ON HYDRAULIC POWER TRANSMISSION

# Cut production costs

The use of mechanical tubing saves time, labour and materials; consequently its use often brings a substantial reduction in production costs. Mechanical tubing is particularly suitable for use in the manufacture of rollers and ring shaped machine parts.

Our extensive stocks include tubes in large and small diameters, in many sizes and various finishes. They are obtainable suitable for machining.

Write for further details so that we may send you a comprehensive booklet listing sizes etc.,

**Markland Scowcroft**
LIMITED

# Between experts

(2)
and as you asked us to take extra care over the flywheel, we used the "sandwich" technique with Ilford Industrial X-ray films B and C. We found that using the two films in one cassette gave us the finest results possible; the Type B film took care of the thick sections and Type C of the thinner web.
You can take it that since the radiographs give the flywheel a clean bill of health, you have nothing to worry about.
With regard to the heavy bronze casting - we are pleased to say that this is now ready for a final check, and we shall of course have it radiographed with the fast Ilford Industrial X-ray film type "G" which is ideal for the purpose.
Yours faithfully,
m. w. f. Smith
Chief Inspector

**ILFORD** **X-RAY FILMS**

**FOR INDUSTRIAL RADIOGRAPHY**

ILFORD LIMITED · ILFORD · ESSEX

TANGYE

ONE AND ALL

CENTRIFUGAL —
TURBINE —
NO-CHOKE —
ACID —
PROPELLER —
RECIPROCATING —
ETC. —

THE BEST KNOWN NAME IN

Pumps

With almost a Century of pumping experience to their credit, Tangyes Limited are able to offer a ready answer to most pumping problems.

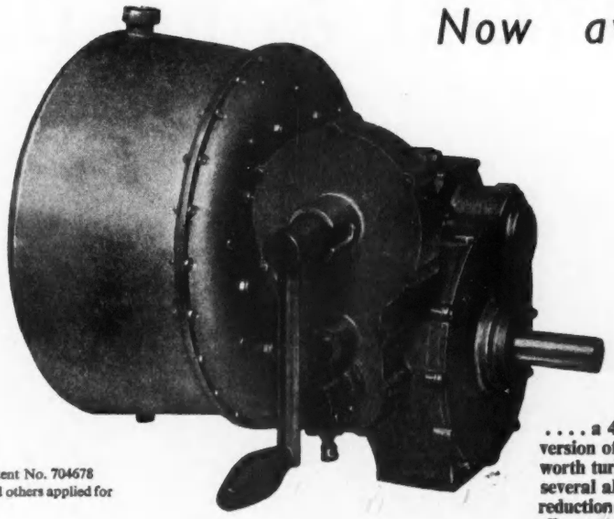
TANGYES LIMITED, PUMPS DIVISION, SMETHWICK, BIRMINGHAM, ENGLAND.

BRANCH HOUSES AT LONDON · MANCHESTER · GLASGOW

AD.30

# BUDWORTH *gas turbines*

*Now available for—*



Patent No. 704678
and others applied for

. . . . a 45/60 h.p. version of the Budworth turbine with several alternative reduction gears for all portable and other power requirements.

Alternators
Fire pumps
Land drainage and salvage pumps
Hydraulic pumps
Ships' generators and auxiliaries
High speed motor boats
Air compressors
Ventilating fans
Propeller turbine for light aircraft
Aircraft H/F generators

Also available as an air compressor, for ventilating and heating purposes, and for processes where a large supply of hot air may be required.

These hand-started gas turbines are without electrics, will burn diesel oil, paraffin, or petrol without alteration, have the highest power/weight ratio of any small gas turbine, and need virtually no maintenance.

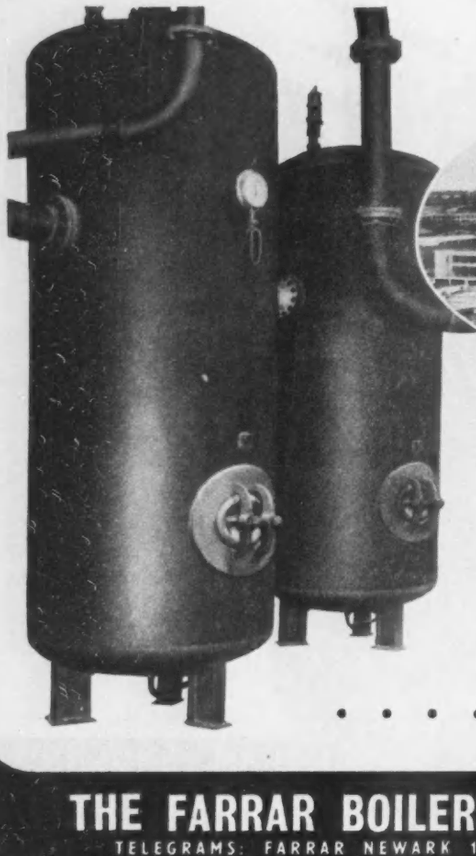
There is no ducting, and for higher powers multiple installations of the basic turbine unit can be built up.

*Please write for further particulars or demonstration*

**DAVID BUDWORTH LTD. - ENGINEERS - HARWICH - ESSEX - TEL 116**

G

# FARRAR
## AIR RECEIVERS



INSTALLED AT

**VAUXHALL MOTORS LTD**

LUTON - BEDS.

THESE PHOTOGRAPHS WERE KINDLY SUPPLIED BY MESSRS. VAUXHALL MOTORS LTD., TO WHOM OUR ACKNOWLEDGEMENTS AND THANKS ARE DUE FOR PERMISSION TO PUBLISH.

• • • • TRADE MARK • • • •

**THE FARRAR BOILERWORKS LTD. NEWARK (Notts) ENGLAND**

TELEGRAMS: FARRAR NEWARK 1143 ★ ★ ★ ★ ★ ★ ★ TELEPHONES: NEWARK 1143-4-5

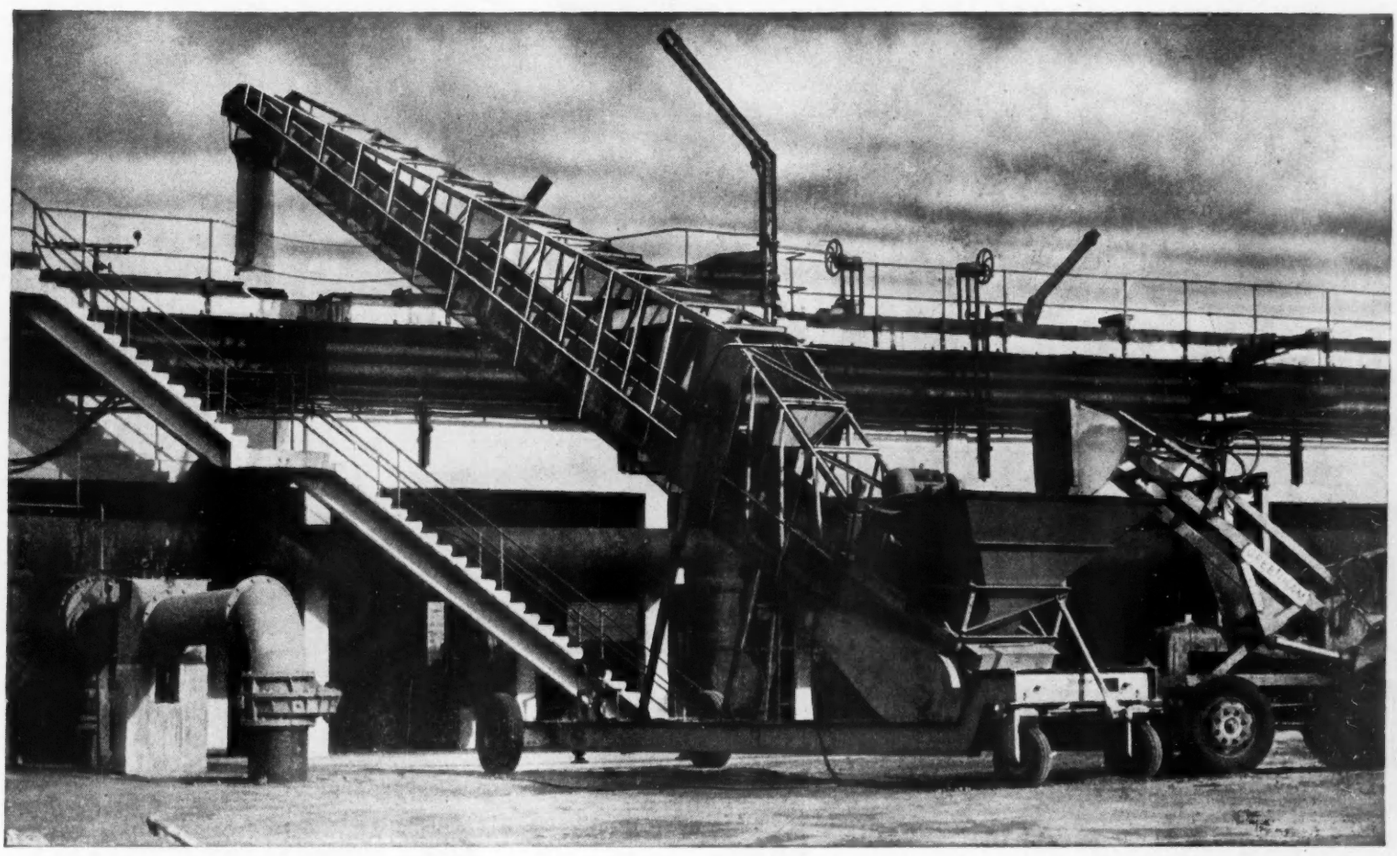
# STEELWORK *by* WARDS

**THOS. W. WARD LTD**

ALBION WORKS · SHEFFIELD

Wards supplied and erected the steelwork for the new Silverdale School, Sheffield, pictured here in course of building. Photograph by permission of J. L. Womersley Esq., F.R.I.B.A., M.T.P.I., Sheffield City Architect.

C.S.24



*The 75-ft. Mobile Stacker. Shown loading iron oxide into overhead purifiers.*

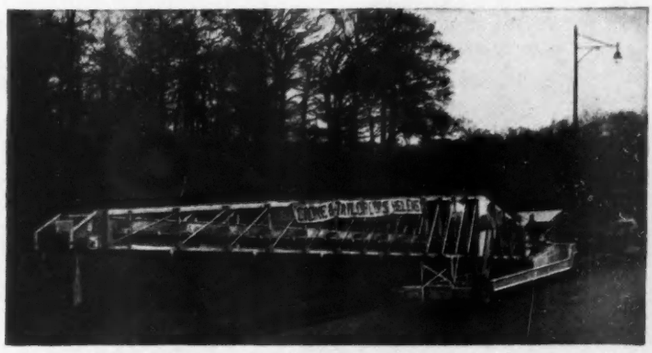
# DURALUMIN lightens the load

REGD. TRADE MARK

A strong stacker, very light to handle—thanks to 'Duralumin'. The 75-ft. conveyor boom of this mobile stacker is constructed mainly of Duralumin 'H' extruded section and plates, fastened with ' MG5 ' rivets and cadmium-plated steel nuts and bolts.

This stacker was made by Crone & Taylor (Engineering) Ltd. for the North Thames Gas Board and is proving particularly suitable not only because it is light to manœuvre and to transport but its constructional material has high resistance to corrosion and needs no painting.

There are sure to be many uses for ' Duralumin ' in your own field for it is used widely in most industries today. Why not write or 'phone our Technical Sales Section, who will be only too glad to help you.



*Stacker being towed to North Thames Gas Board from the makers.*

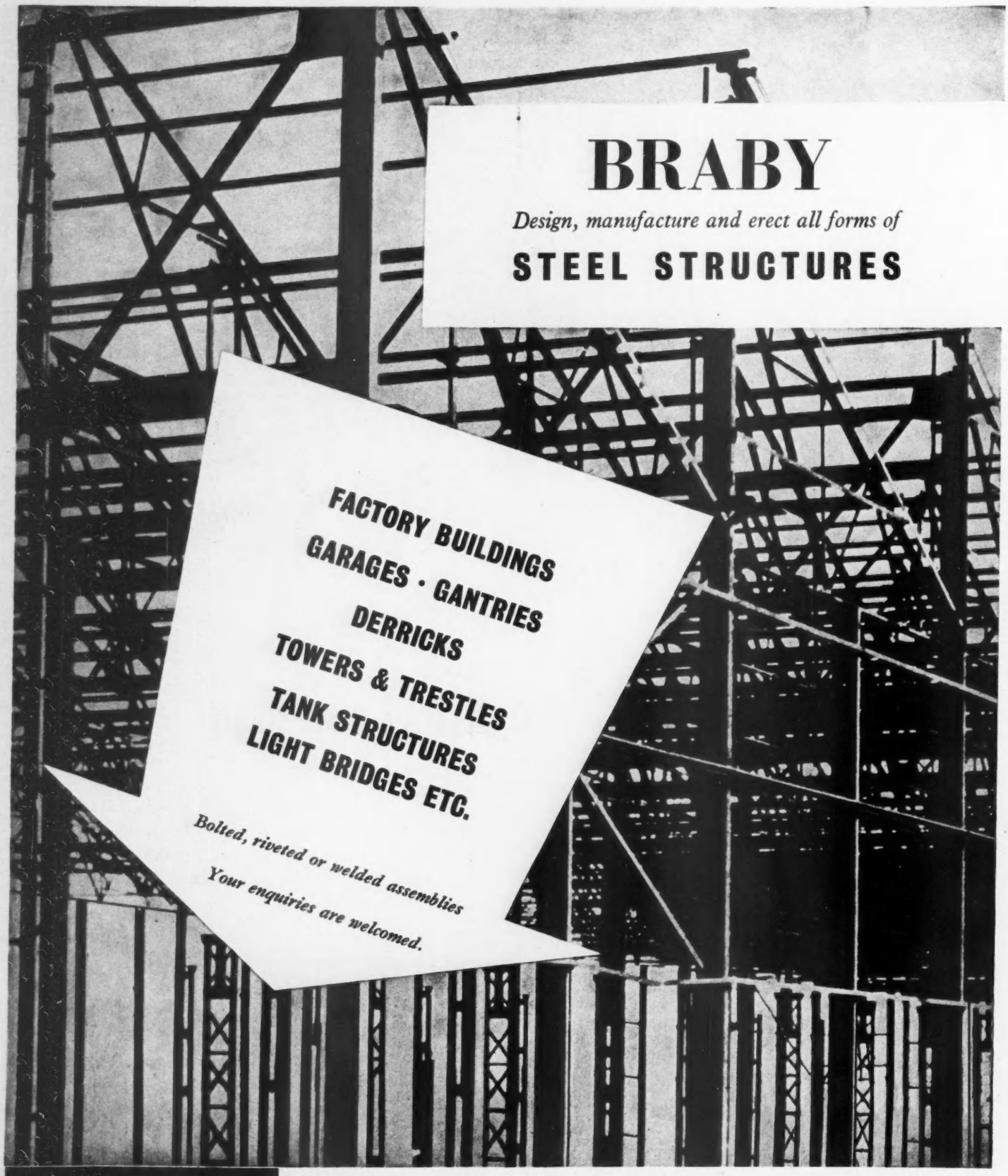
James Booth

BOOTH BIRMINGHAM

**JAMES BOOTH & COMPANY LIMITED, ARGYLE STREET WORKS, BIRMINGHAM**

*Extrusions, large forgings, plate, sheet, strip, tubes and wire in brass and copper as well as light alloys.*

TGA 18092




ONE OF THE WIDE RANGE OF

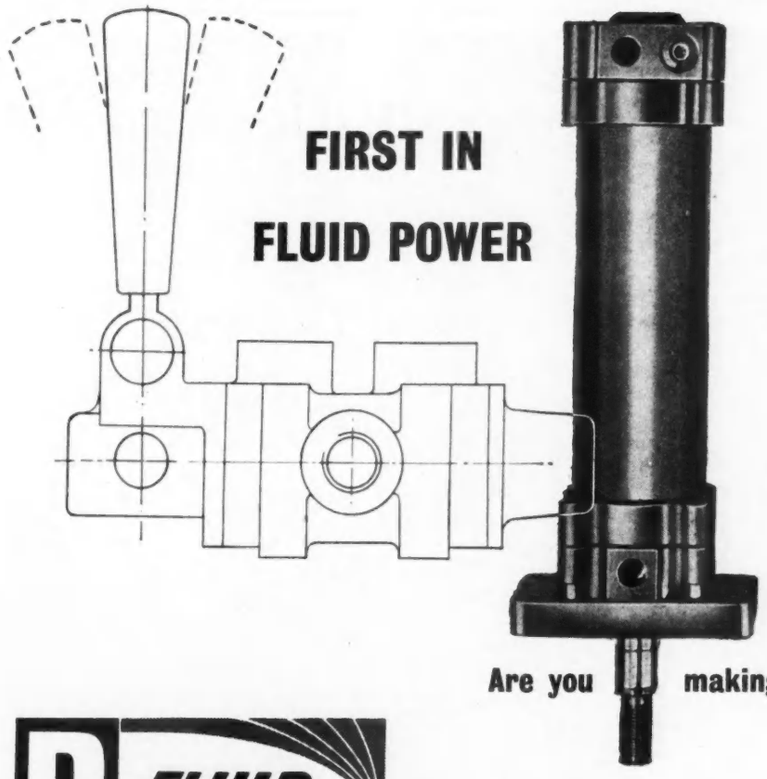
BRABY

PRODUCTS

**FREDERICK BRABY & COMPANY LIMITED**

Head Office: 352-364 EUSTON ROAD, LONDON, N.W.1. TELEPHONE: EUSton 3456
FACTORIES AT: London Works, Thames Road, Crayford, Kent. TELEPHONE: Bexleyheath 7777
Havelock Works, Aintree, Liverpool, 10. TELEPHONE: Aintree 1721
Eclipse Works, Petershill Road, Glasgow, N. TELEPHONE: Springburn 5151
Ashton Gate Works, Bristol, 3. TELEPHONE: Bristol 64041. And Falkirk
OTHER OFFICES: 110 Cannon Street, London, E.C.4. (Export). TELEPHONE: MANsion House 6034
Queen's Buildings, 10 Royal Avenue, Belfast. TELEPHONE: Belfast 26509
Palace Street, Plymouth. TELEPHONE: 62261

AP205



# FIRST IN FLUID POWER

Wherever steady, controlled movement is required oil-hydraulics really come into their own.

Most hydraulic equipment, however, is designed and built primarily for high-pressure operation. When used for low-pressure applications it runs at a fraction of capacity and it would therefore be far cheaper to design and build hydraulic equipment specially for low-pressure operation.

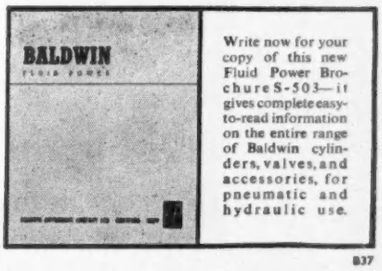
The new range of Baldwin low-pressure hydraulics meets this need. Right from the drawing-board stage this equipment keeps one aim in view—RELIABILITY. Polished hard-chrome plated cylinder bores and piston rods; self-adjusting oil and water resistant seals; rugged malleable cast iron and steel construction, completely rust and corrosion proof inside and out; built-in cushioning to absorb the shock of heavy loads moving at high speeds, and many other quality design features ensure absolute efficiency even under the most arduous conditions. Unit construction enables Baldwin to offer 432 standard types of cylinder with 6 bore sizes and 8 standard mountings.

Ask any discriminating buyer, he will tell you that it *pays* to specify Baldwin low-pressure hydraulics.

**Are you making the most of LOW-PRESSURE HYDRAULICS?**

B FLUID POWER

**BALDWIN FLUID POWER**




Write now for your copy of this new Fluid Power Brochure S-503—it gives complete easy-to-read information on the entire range of Baldwin cylinders, valves, and accessories, for pneumatic and hydraulic use.

**BALDWIN INSTRUMENT COMPANY LIMITED · DARTFORD · KENT · DARTFORD 2948**

*One of the Harper Group of Companies*

B37

# LYNCH LAW for VERMIN

Summary execution is the only way to deal with such vicious thieves and despoilers as rats and mice, and we're the guys to do the job. Instead of a noose we employ modern, scientific methods of destruction, and we also kill those equally horrible plunderers of property, fleas, bugs, cockroaches, ants and crickets. If your property is being raided, let us send a posse to your aid. DELAY MEANS INCREASED LOSSES.

## B. L. & N. PHILLIPS LTD.

***Vermin Destroyers***

124 SOUTHWARK ST., LONDON, S.E.1. Tel.: WATerloo 5546

BIRMINGHAM: 208 County Chambers, 66½ Corporation Street. Tel.: Central 1176

BRISTOL: Swan House, 112 Hotwell Road, 8. Tel: Bristol 20512, Ext. 5

EXETER: 21 Church Lane, Sidwell Street. Tel.: Exeter 54181

EDINBURGH: Pesticidal Services (Scotland) Ltd., 34 Bernard St., Leith, 6. Tel.: Leith 38393

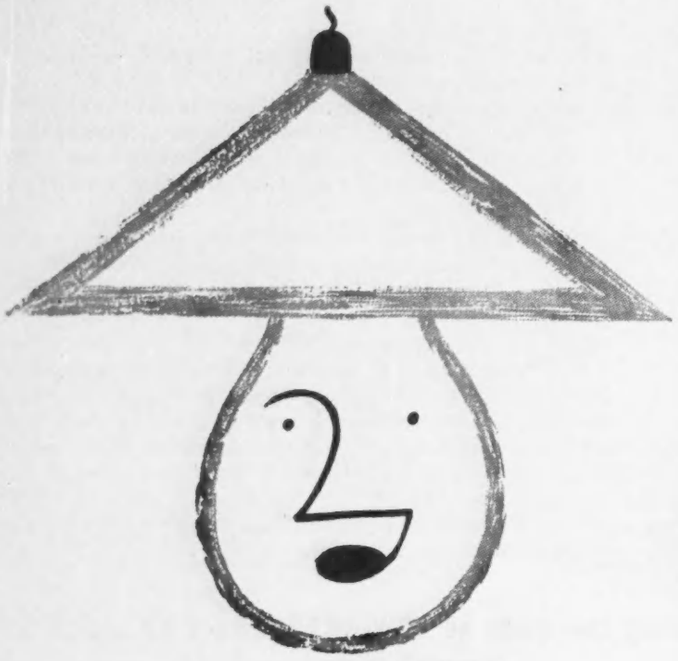
GLASGOW: Pesticidal Services (Scotland) Ltd., 93 Waterloo St. Tel.: City 0735

SOUTHAMPTON: 14 Howard Rd. Shirley. Tel.: Southampton 25307

LEEDS: 21 Upper Mill Hill. Tel.: Leeds 2-5266

LIVERPOOL: 8a Rumford Place, 3. Tel.: Central 2068

BELFAST: Pesticidal Services (Ireland) Ltd., 153 Upper North Street. Tel.: Belfast 26998



# HEY!

## I'M WASTING YOUR MONEY

…an't compete against sunlight, you …ow! In fact, I look so dim in daylight …at they keep forgetting to switch me …ff. But I'm still bright enough to see hat I'm wasting electricity! Why don't you fit a SAVELITE?

Why not, indeed? The 'Savelite' is a new photo-electric device which warns factory and office workers when to switch off unnecessary lights. Easily and cheaply installed in individual offices and workshops, it *cuts* electric light bills to the barest minimum, and saves its cost in a very short time.

*A 'Savelite' is a neat little photo-electric u it that fits in the window and literally watche daylight and tells you when artificial lighting is not required. Take a walk round your works—it may surprise you to see how much money is being wasted on unnecessary lighting (lights which they have* **forgotten** *to switch off!) The 'Savelite' unit costs only 23 gns.—quickly saved out of your electricity bill. And remember—more light is wasted in the lighter months.*

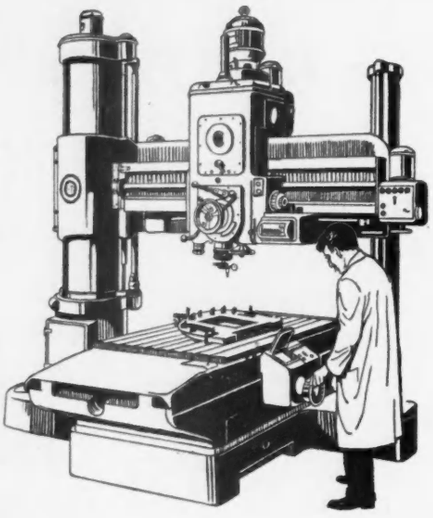
CUT THOSE ELECTRICITY BILLS BY INSTALLING

# SAVELITE

**IT REACTS TO LIGHT AS A THERMOSTAT REACTS TO HEAT**

*Full details from :*
**RADIOVISOR PARENT LTD.,** Stanhope Works
61▼ High Path, London, S.W.19 *Tel : CHErrywood 3351*
RADIOVISOR **MAKERS OF ELECTRONIC CONTROLS SINCE 1927**

# jig boring with optical accuracy



BIRMINGHAM AND BLACKBURN CONSTRUCTION CO. LTD.

**The pride of our machine shop is our Optical Jig Borer, which makes possible machinery limits as fine as ± ·000125 on most types of work. We look forward to receiving your enquiries for the jigs and tools that require that little "extra" that is possible with plant of this nature.**

**Armoury Close, Bordesley Green, Birmingham 9 and at Harley St. Blackburn.**

# Cut SET-UP COSTS!

ALL SIZES DELIVERED EX-STOCK

## Change to ROCKWELL HELICAL CLAMPS

BRITISH PATENT

Why waste time building up rickety, makeshift clamps with anything that's handy? Get on the phone today and ask for full information about Rockwell Helical Clamps. These ingenious clamps have been designed for simple quick and positive mounting, with negligible clamp projection over work piece. Each clamp is a complete unit, with no parts to lose.

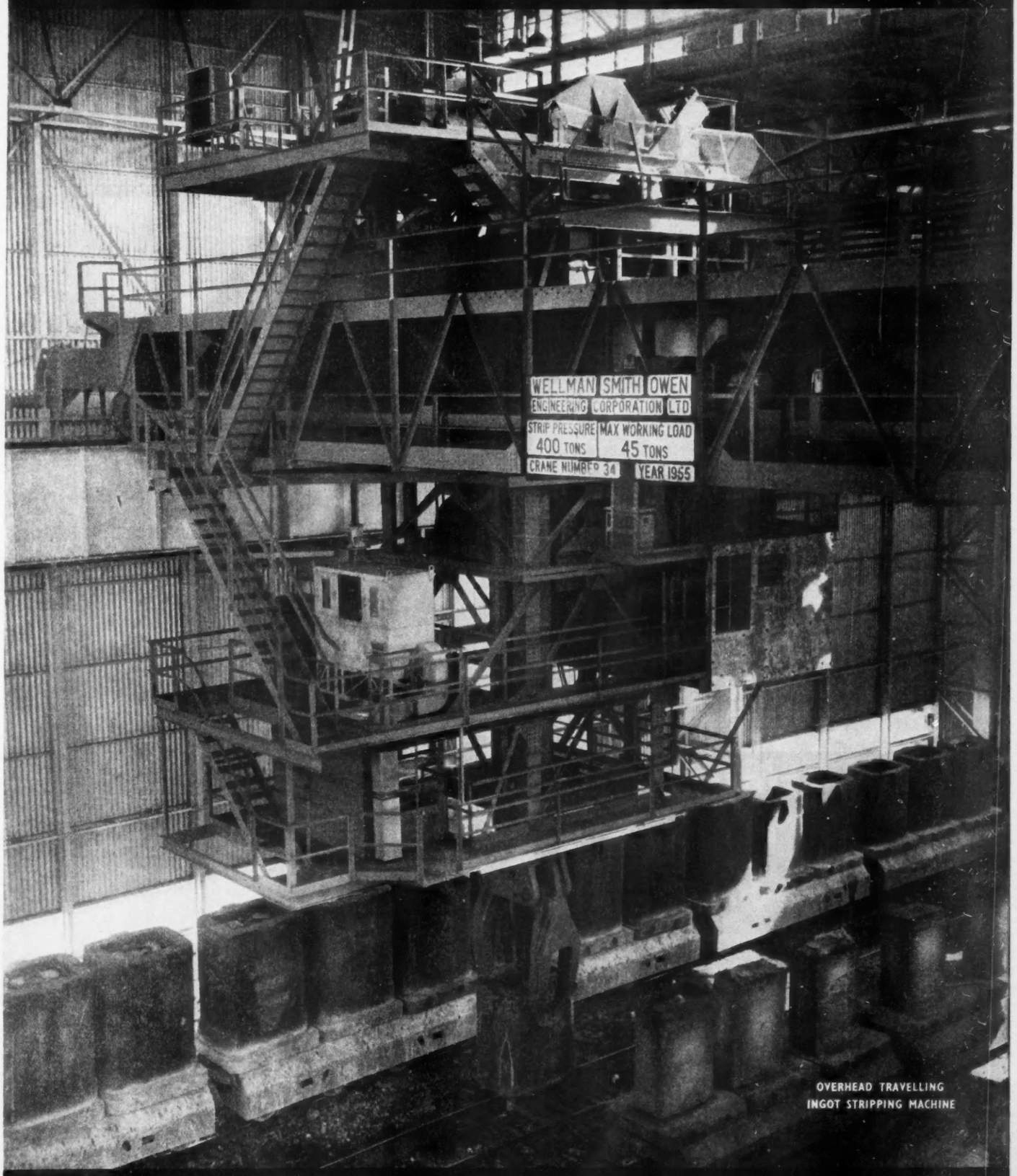
● WRITE OR PHONE FOR LEAFLET GIVING PRICES SIZES AND FULL TECHNICAL DETAILS -TODAY!

WELSH HARP, EDGWARE RD., LONDON, N.W.2. TEL. GLADSTONE 0033 ROCKWELL MACHINE TOOL CO. LTD.

ALSO AT BIRMINGHAM – TEL: SPRINGFIELD 1134/5 • STOCKPORT – TEL: STOCKPORT 5241 GLASGOW – TEL. MERRYLEE 2822

S.C.5

# Wellman Steelworks Plant

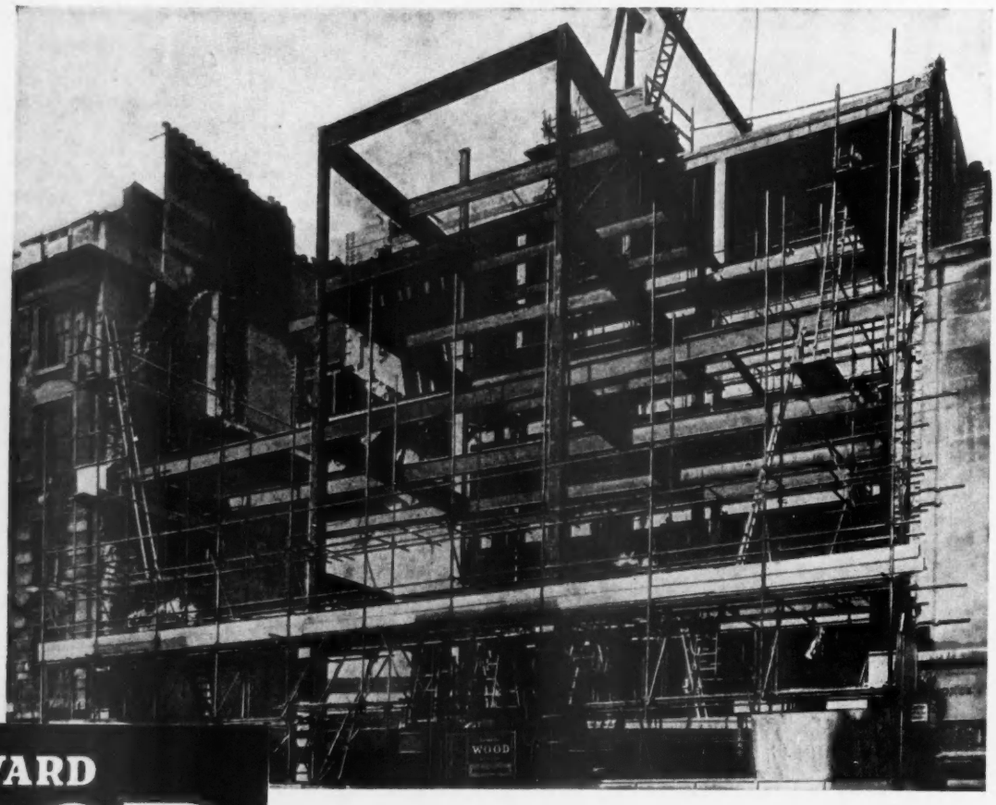



OVERHEAD TRAVELLING
INGOT STRIPPING MACHINE

THE WELLMAN SMITH OWEN ENGINEERING CORP. LTD.

PARNELL HOUSE, WILTON ROAD, LONDON, S.W.1 WORKS: DARLASTON, South Staffs, & BELFAST

# Landmarks of the Future



Architect : G. S. Hay, A.R.I.B.A.
Architects Dept., C.W.S.
Limited, Manchester.

EDWARD WOOD & CO LTD

CONSTRUCTIONAL ENGINEERS

Deansgate, Manchester, is the site of this striking new building at present under construction for Co-operative Emporium Limited. Bringing a new department store into the heart of Manchester's Shopping area, this will be another landmark with Steelwork by Edward Wood & Co. Limited.

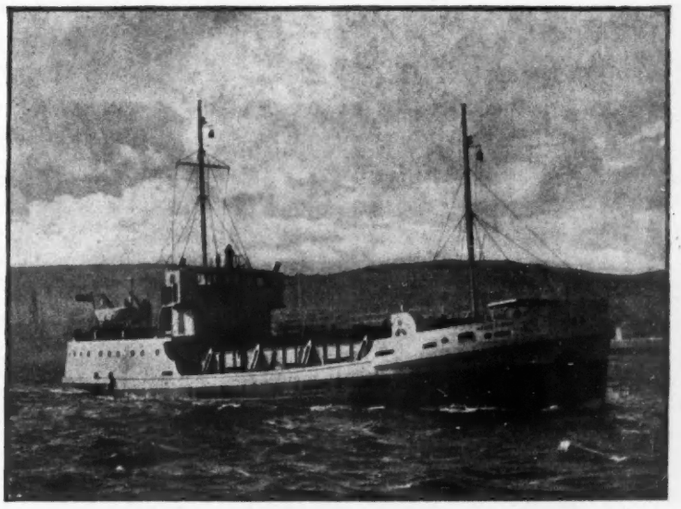
*Registered Office and Works :*

**OCEAN IRONWORKS · TRAFFORD PARK · MANCHESTER 17**

*London Office : 68 Victoria Street, S.W.1. Telephone : VICtoria 1331/2 · Technical Offices at Birmingham & Nottingham*

dm WD 63

# Carrying rock to Liverpool . . . . . .



This is the "Mersey No. 42", a hopper barge recently completed for service with the Mersey Docks & Harbour Board. It will be used to carry rocks from Anglesey to Liverpool for the building up of the training walls there. From the Mersey, to Montevideo and Madagascar, the name "Lobnitz" stands for reliability and craftsmanship.

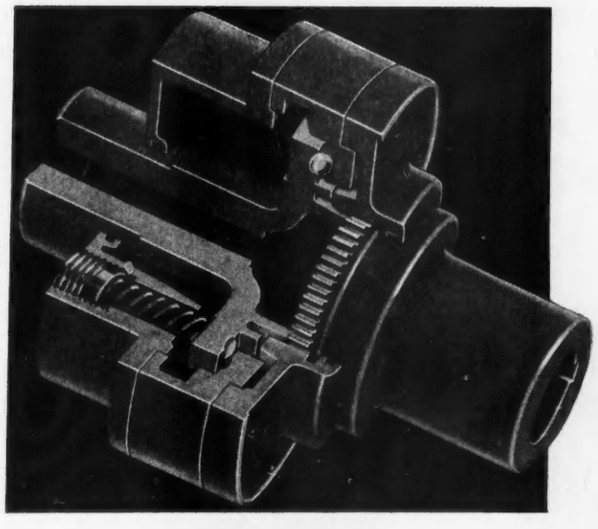
Lobnitz THE NAME TO REMEMBER IN DREDGING

MULTI-BUCKET DREDGES · SUCTION DREDGES · DIPPER DREDGES · GRAB DREDGES · HOPPER BARGES · ROCK BREAKERS · HARBOUR CRAFT GENERALLY

LOBNITZ & CO., LTD., RENFREW, SCOTLAND RENfrew 2216
*LONDON OFFICE:* 55/61 MOORGATE E.C.2. MONarch 5101

# COMPLETE PROTECTION

## AGAINST OVERLOADS

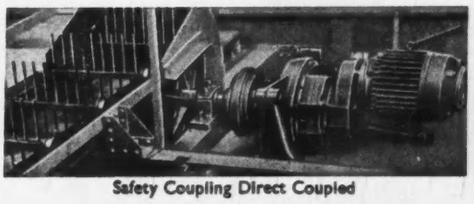


IN CASE OF OVERLOAD, THE SAFETY COUPLING TRIPS AND AUTOMATICALLY STOPS THE MOTOR

NOMINAL TORQUES FROM 1,000 TO 34,700 LB. IN.

## *THE A.S. SAFETY COUPLINGS*

ACCURATE AND RELIABLE SETTING
MAXIMUM SPEED 500 R.P.M.



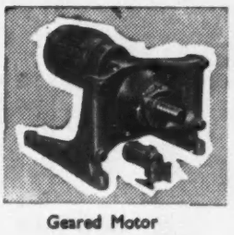
Safety Coupling Direct Coupled

Safety Coupling with Pinion

## OTHER SADI PRODUCTS

*INCLUDE:*
GEARED MOTORS • SPEED REDUCERS
SADIVAR VARIABLE SPEED UNITS
HAULAGE CAPSTANS · MACHINE TOOL DRIVES
***Please ask for appropriate literature.***

Sadivar Variator

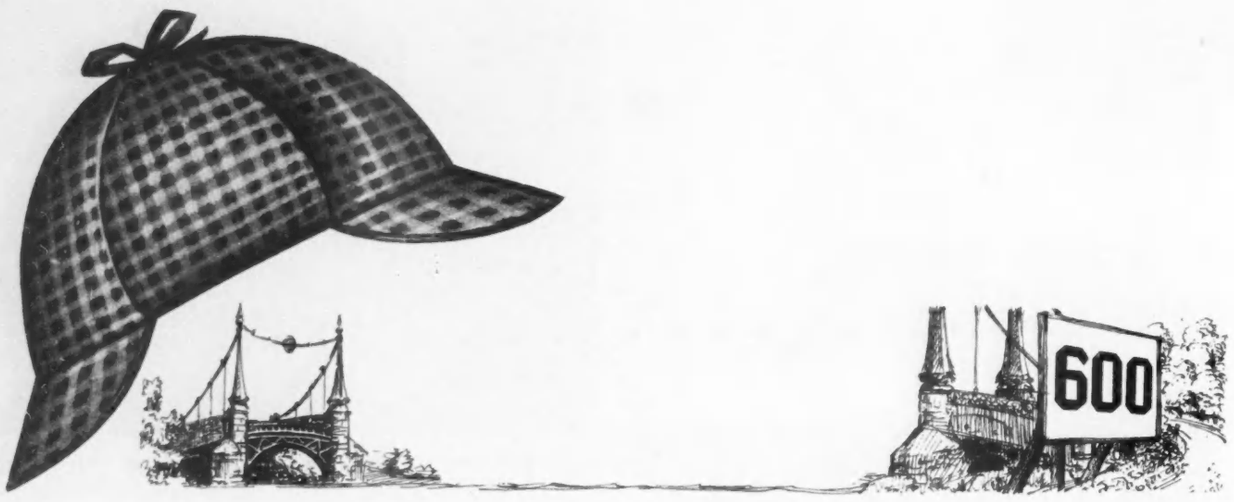


Geared Motor

Haulage Capstan

## SADI ENGINEERING CO. LTD.

10-14 ANSDELL STREET, KENSINGTON SQUARE, LONDON, W.9. *Telephone:* WESTERN 7653 *Cables:* SADIUNIT LONDON




# The case of the Missing Bridge

"Perhaps it was *burned* down, Holmlock."

"Oh come, My Dear Watnot, where are the 'vestigia'—the charred remains. This is the work of a master organization: no débris, not a solitary fingerprint—only that cryptic sign "600" at the bridge approaches."

"A magic number, perhaps, Holmlock . . . "

"What an incurable romantic you are, Wat——— By Thunder, that's it, of course. When it comes to dismantling work, "600" is the nearest thing to magic that there is."

THE 600 GROUP OF COMPANIES

**GEORGE COHEN**

**SONS AND COMPANY LIMITED**

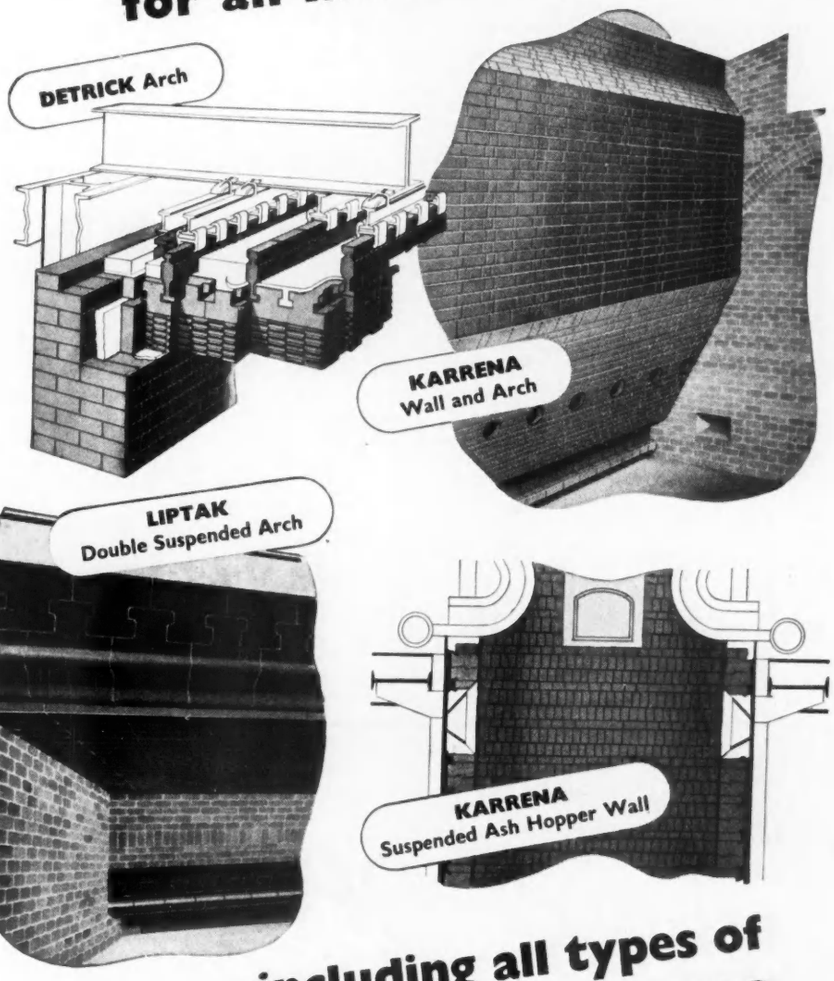
*Established 1834*

WOOD LANE, LONDON, W.12 · *Telephone:* Shepherds Bush 2070 · *Telegrams:* Coborn, Telex, London

And at 600 Commercial Road, E.14 · Bidder Street, Canning Town, E.16 · Bath · Belfast · Birmingham · Hebburn-on-Tyne · Leeds Luton · Manchester · Sheffield · Swansea

# GLENBOIG FIREBRICKS

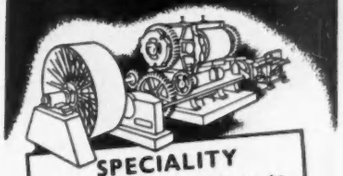
## for all Industrial Purposes..




## ...including all types of SUSPENDED WALLS and ARCHES

THE GLENBOIG UNION FIRE CLAY CO LTD · GLENBOIG · LANARKSHIRE · SCOTLAND
Export Agents GENERAL REFRACTORIES LTD · GENEFAX HOUSE · SHEFFIELD 10

BENNETT & SAYER
LIMITED
*Established 1877*
ENGINEERS IRONFOUNDERS & GENERAL MILLWRIGHTS



SPECIALITY
Plastic brick machinery to suit all clays, any capacity

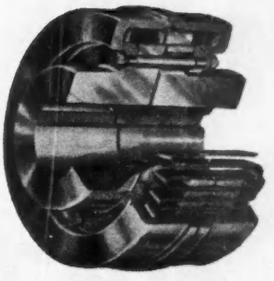
NUNS FOUNDRY, NUNS STREET
DERBY
Telegrams : BENNETT & SAYER, DERBY
Telephone : OFFICE and WORKS – 45546

**STEEL FRAME BUILDINGS**
OF EVERY DESCRIPTION
Factories, Sheds, Mill Buildings, Foundries, Bungalows, Etc.
*SPECIALITIES*
Pit Headgear, Pumping Stations, Power Stations.

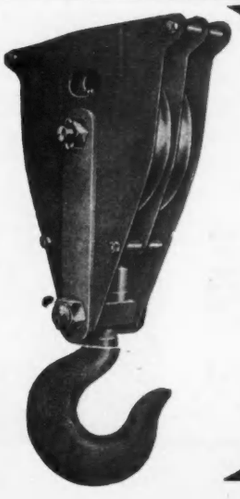
*Bridgework and Riveted Work of all descriptions*

**BROWNLIE and MURRAY LTD.**
POSSIL PARK, GLASGOW
LONDON: 32, QUEEN VICTORIA ST., E.C.4.

BIBBY COUPLINGS



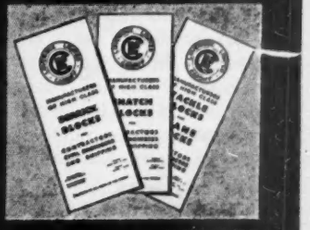
THE WELLMAN BIBBY Co., Ltd.,
Parnell House, 25, Wilton Road, London, S.W
Telephone : ABBEY 1194



# LOVERIDGE LTD

151-153 BUTE STREET, DOCKS, CARDIFF

Manufacturers of High Class
**CRANE BLOCKS**
**PULLEY BLOCKS**
**& PATENT SNATCH BLOCKS**
for Wire Rope



Telephone: CARDIFF 23641 Send for Brochures

# BRIGHT STEEL

ROUNDS · HEXAGONS

SQUARES · FLATS & SECTIONS

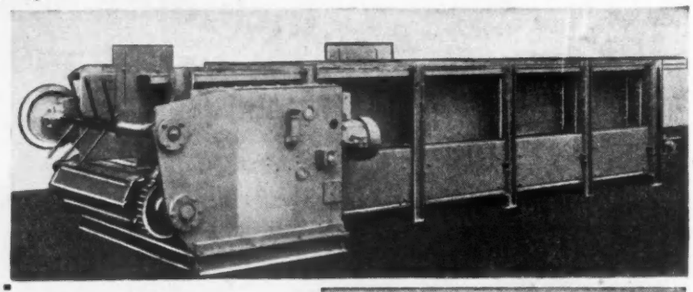
# THE HALESOWEN STEEL Co., LTD

HALESOWEN
Nr. BIRMINGHAM
HALESOWEN 1191

68 VICTORIA ST.
LONDON, S.W.1. VIC: 6992
8 CHATHAM ST.
MANCHESTER, 1. CEN: 0413

# IVO NEW, FULLY HYDRAULICALLY OPERATED BOX-FEEDER

FOR THE REGULAR AND CONSISTENT FEEDING OF ONE OR MORE CLAYS, SHALES, SAND, COKE ETC. IN CONTROLLED AND PROPORTIONATE AMOUNTS.

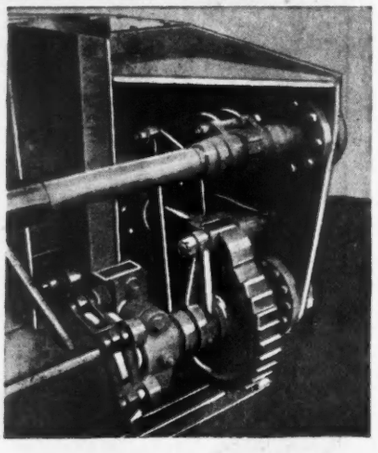


The IVO Hydraulic Box Feeder has a rectangular hopper with as many adjustable gates as required. Its sides are tapering towards the top and rear. A very substantial slatted steel conveyor supported on 3 rollers over its width forms the bottom. This conveyor is propelled by means of a ratchet drive. The driving pawl being attached to the end of a hydraulic ram, the stroke speed of which is readily adjustable by means of a simple hydraulic control lever.

A mixing shaft with prickers or knives is provided at the output end and this is also operated by means of double-acting hydraulic ram. The whole of the hydraulic driving gear and its electric motor are entirely dust and weatherproof and self contained. Damage or breakage of the conveyor or other moving parts is impossible since in the event of an overload or jamming, the pressure release valve will lift and unload the hydraulic system and the conveyor etc. will stop till the jam or obstruction has been cleared.

**Hopper sizes from 15′ to 30′ x 4′ x 2′ 6′ approx; hourly feed capacities, infinitely variable from nothing - 30 cubic yards per hour.**

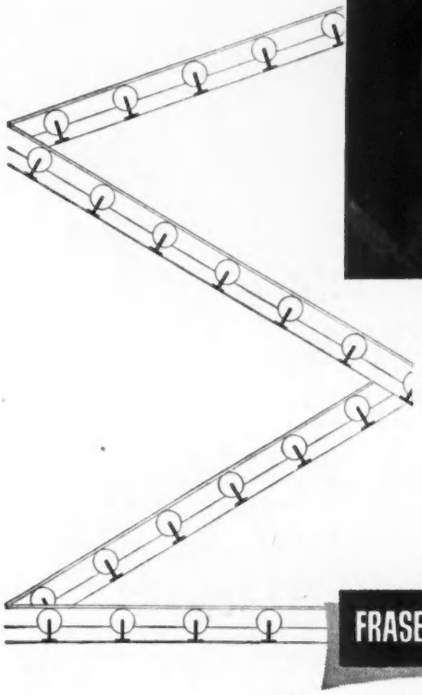
*The purpose of this machine is to provide under most arduous conditions a regular and reliable feed of one or more materials to the processing machines of the heavy clay, ceramic, cement and many other industries.*



IVO ENGINEERING & CONSTRUCTION CO. LTD., LONDON, W.12

*Telephone: SHEpherds Bush 4382/5 (4 lines).*

**balance brought forward...**



Moving materials as cheaply as possible constitutes sound economics. Companies who have installed modern conveyor equipment have found it a positive contribution to a favourable balance sheet.

The design and installation of conveyors is very properly the business of specialists, and internationally famous in this field are Fraser & Chalmers, and their associate, Hewitt Robins.

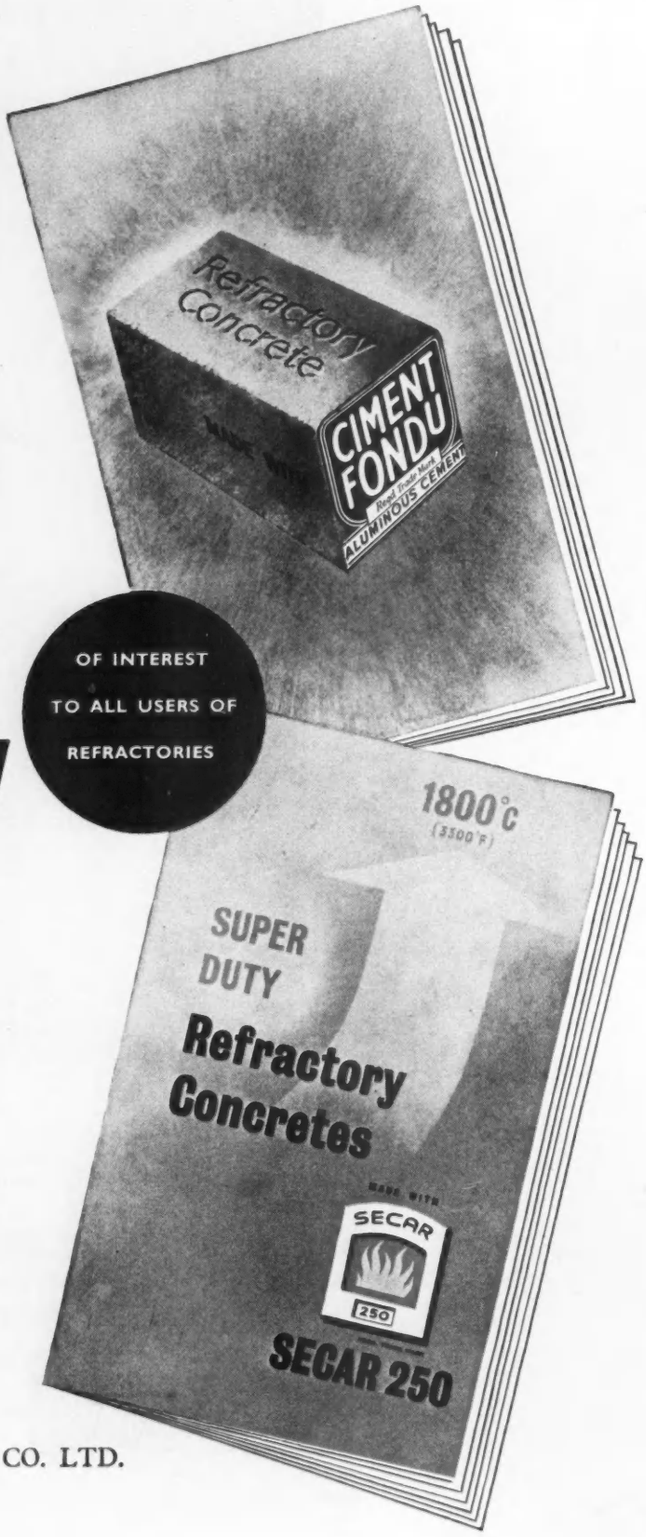
FRASER & CHALMERS

FRASER & CHALMERS ENGINEERING WORKS
ERITH · KENT

MH 101

THE GENERAL ELECTRIC CO. LTD. OF ENGLAND

# Free, **NEW,** highly informative booklets on **Refractory Concretes**




OF INTEREST TO ALL USERS OF REFRACTORIES

Every user of Refractories will find one or both of these handy new publications invaluable. They answer many queries and may solve some problems.

Packed with important information from cover to cover, they deal in detail with every aspect of REFRACTORY CONCRETES.

› *Write* **NOW** *for your copy of Refractory Concrete booklet and/or Super Duty Refractory Concrete booklet.*

LAFARGE ALUMINOUS CEMENT CO. LTD.
73 Brook Street, London, W.1.
Tel: MAYfair 8546

AP/24

*NEW!*

**A 12 POINT RING BOLT FOR USE WITH RING SPANNERS**

**ANOTHER UNBRAKO CONTRIBUTION TO INDUSTRY . . . . . .**

Unbrako, world leaders in the manufacture of internal wrenching bolts, make a new contribution to industry—an external, 12 point bolt specially designed for ring spanners, and with a host of applications.

Naturally, it's a fine precision job, subject to every Unbrako quality test, and it has many advantages over ordinary hex bolts. For example, the 12 point head gives double purchase, the wide toughened shoulders give a greater and stronger bearing area.

But most important of all, these new 12 point bolts are made by Unbrako — your basic assurance of quality and reliability. Details of sizes and threads will gladly be supplied on request.

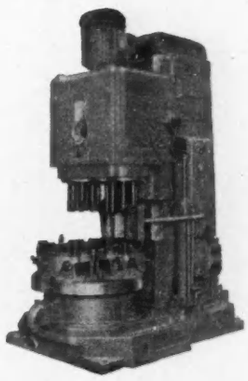


See how a ring spanner grips the 12 point ring bolt while the greater bearing area ensures an even tighter joint.

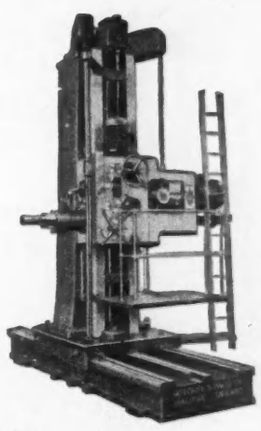
UNBRAKO

UNBRAKO SOCKET SCREW CO LTD · COVENTRY

**K&W FOR DRILLING, BORING, TAPPING & HONING MACHINES**

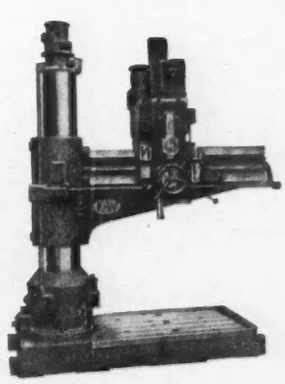


Automatic Cycle Multiple Machines



**H.14**

3" Spindle Horizontal Machine
36 Speeds, Milling Feeds, Verniers



**E.27**

36 Speed Radials
6ft., 7ft. and 8ft. radius

**KITCHEN & WADE LTD.**
**HALIFAX, ENGLAND**

*Phone :* Halifax 61173

# Faster-more efficient

## BOILER CLEANING

Why waste time brushing smoke tubes, and rodding clinker and birds nesting, when a few minutes with a Percussion Lance will shift everything from Economisers, Airheaters, Water Tubes, Fire Tubes, etc.

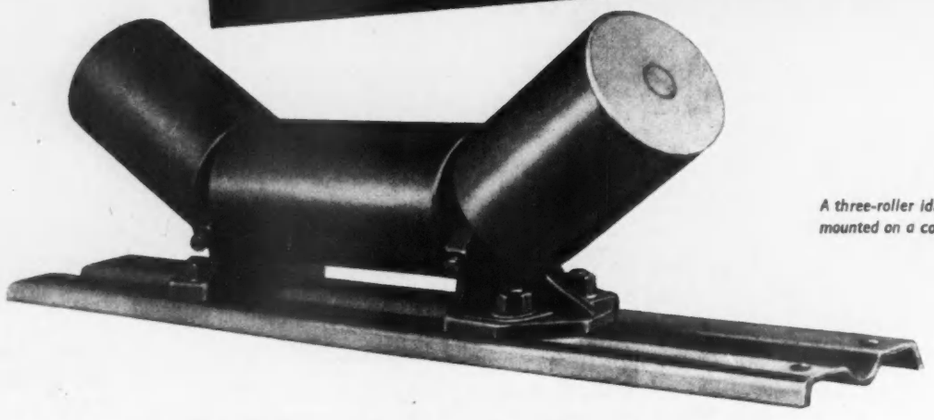
**See this new cleaning tool in action at your own works— write to**
**AIRNESCO PRODUCTS LIMITED**
KNIGHT ROAD, STROOD, ROCHESTER, KENT
Telephone: Strood 78310

**AIRNESCO Percussion LANCE**

*Throughout the plant of Messrs. Judkins Ltd., at Nuneaton, the stone travels on M&C idlers. The conveyors shown run from the primary crusher to screens, then to stockpiles, then from the reclaiming tunnel to secondary crushers, and to and from screens. There are many other M&C conveyors here.*

# FOR IMPORTANT BELT CONVEYORS

# THEY CHOOSE M&C IDLERS



*A three-roller idler mounted on a corrugated idler-board.*

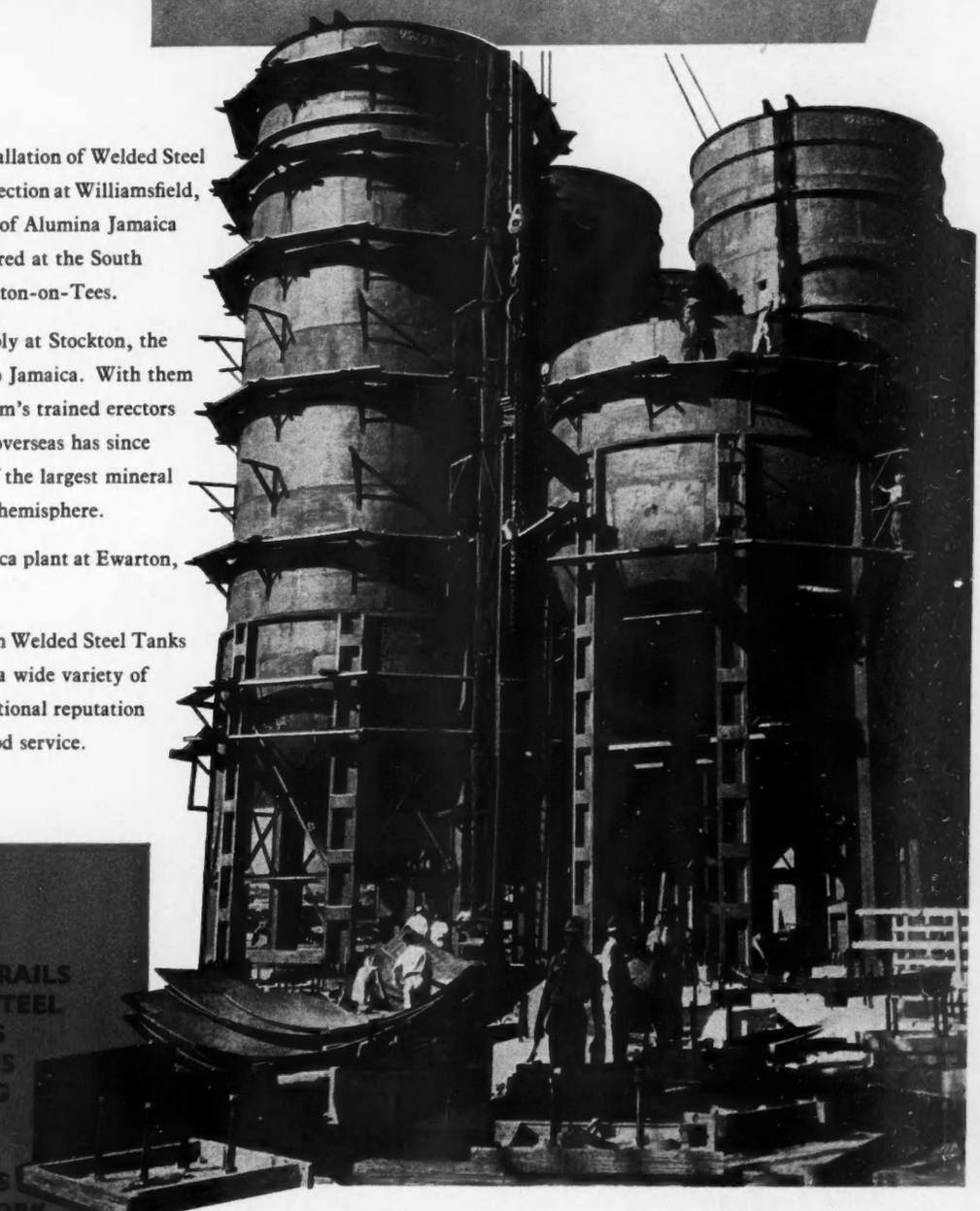
*Where belt conveyors are relied on to take the flow from faces or hoppers, crushers or screens—in fact, wherever the output depends on belt conveyors—the first choice for their support is M&C idlers. The ease with which these idlers run, year after year, in spite of dust and dirt, makes life longer for the belts and easier for the maintenance staff.*

**MAVOR & COULSON LTD**

*Bridgeton Glasgow S.E.*
*Olive Grove Road Sheffield 2*
*36 Victoria Street London S.W.1*

**STEEL PRODUCTS OF INTERNATIONAL REPUTE**

# South Durham in JAMAICA



Here is one small part of an installation of Welded Steel Precipitator Tanks in course of erection at Williamsfield, Jamaica, at the Kirkvine Works of Alumina Jamaica Ltd. The tanks were manufactured at the South Durham Malleable Works, Stockton-on-Tees.

After fabrication and test assembly at Stockton, the component parts were shipped to Jamaica. With them went a full crew of South Durham's trained erectors and welders whose tour of duty overseas has since covered the installation of one of the largest mineral processing plants in the western hemisphere.

Work on a similar Alumina Jamaica plant at Ewarton, is now nearing completion.

All over the world, South Durham Welded Steel Tanks and Pressure Vessels are serving a wide variety of industries and maintaining the national reputation for high quality products and good service.

**Other South Durham manufactures include:**
STEEL PLATES · STEEL RAILS AND ACCESSORIES · STEEL JOISTS AND SECTIONS BROAD FLANGE BEAMS LARSSEN STEEL PILING 'RENDHEX' FOUNDATION COLUMNS · STEEL PIPES STRUCTURAL STEELWORK ELECTRICALLY WELDED FABRICATIONS

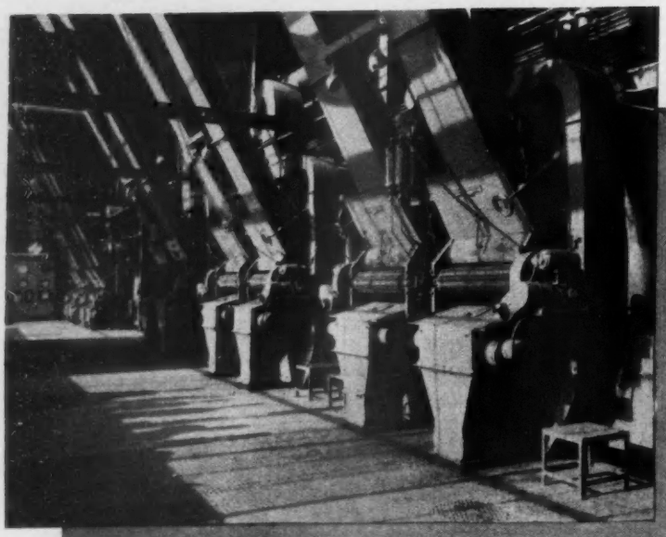
*The services of the South Durham Technical Advisory and Drawing Office Staffs are available at all times to engineers engaged in the planning or development of projects involving the use of any of the Company's products.*

## SOUTH DURHAM STEEL AND IRON COMPANY LIMITED

*Central Sales Office:* **CARGO FLEET IRON WORKS, MIDDLESBROUGH, YORKS.**

Telephone: Middlesbrough 2631 (14 lines). Telegrams and Cables: "Carfleco," Phone, Middlesbrough. Also at West Hartlepool, Stockton-on-Tees and London.

## Efficient Burning of *low grade fuel* in Shell Boilers



John Thompson Triumph Travelling Grate Stokers and handling plant serving five boilers at Joseph Sankey & Sons Ltd., Bilston. Consulting Engineers for this new boiler plant were Messrs. Powell Duffryn Technical Services Ltd.

### THE THOMPSON TRIUMPH TRAVELLING GRATE STOKER

Steam engineers to-day are faced with the problem of maintaining the required output of steam with fuel which is variable in quality, dear in price and often of the lowest grade. Here is one answer: it is possible to burn even the cheaper low grade fuels efficiently and completely with the Thompson Triumph Stoker.

A modified Thompson Triumph Travelling Grate Stoker is available which will successfully burn coke breeze, one of the cheapest fuels.
It will pay you to investigate — write for Brochure "The Best Way to Fire a Shell Boiler".

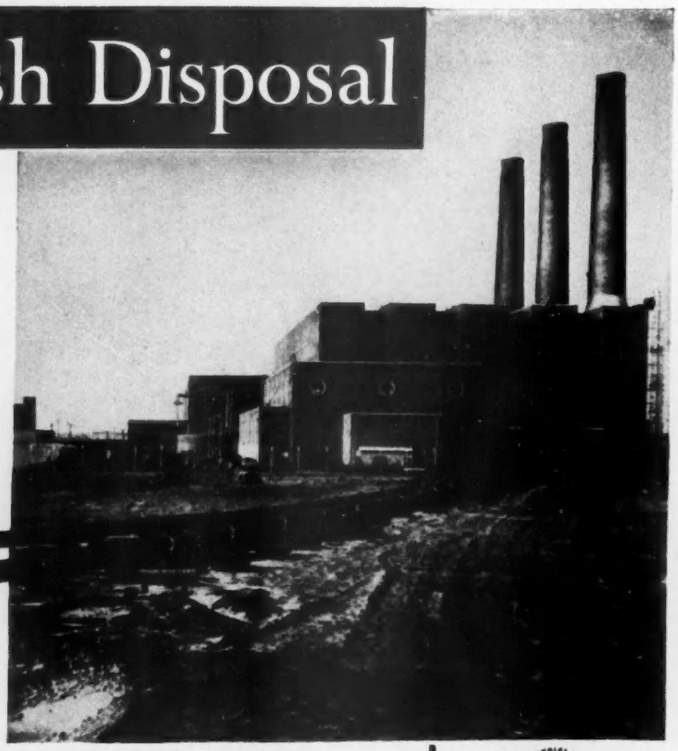
**JOHN THOMPSON (TRIUMPH STOKER) LIMITED · LEEDS**

JOHN THOMPSON GROUP

PT/1

## Hydraulic Ash Disposal

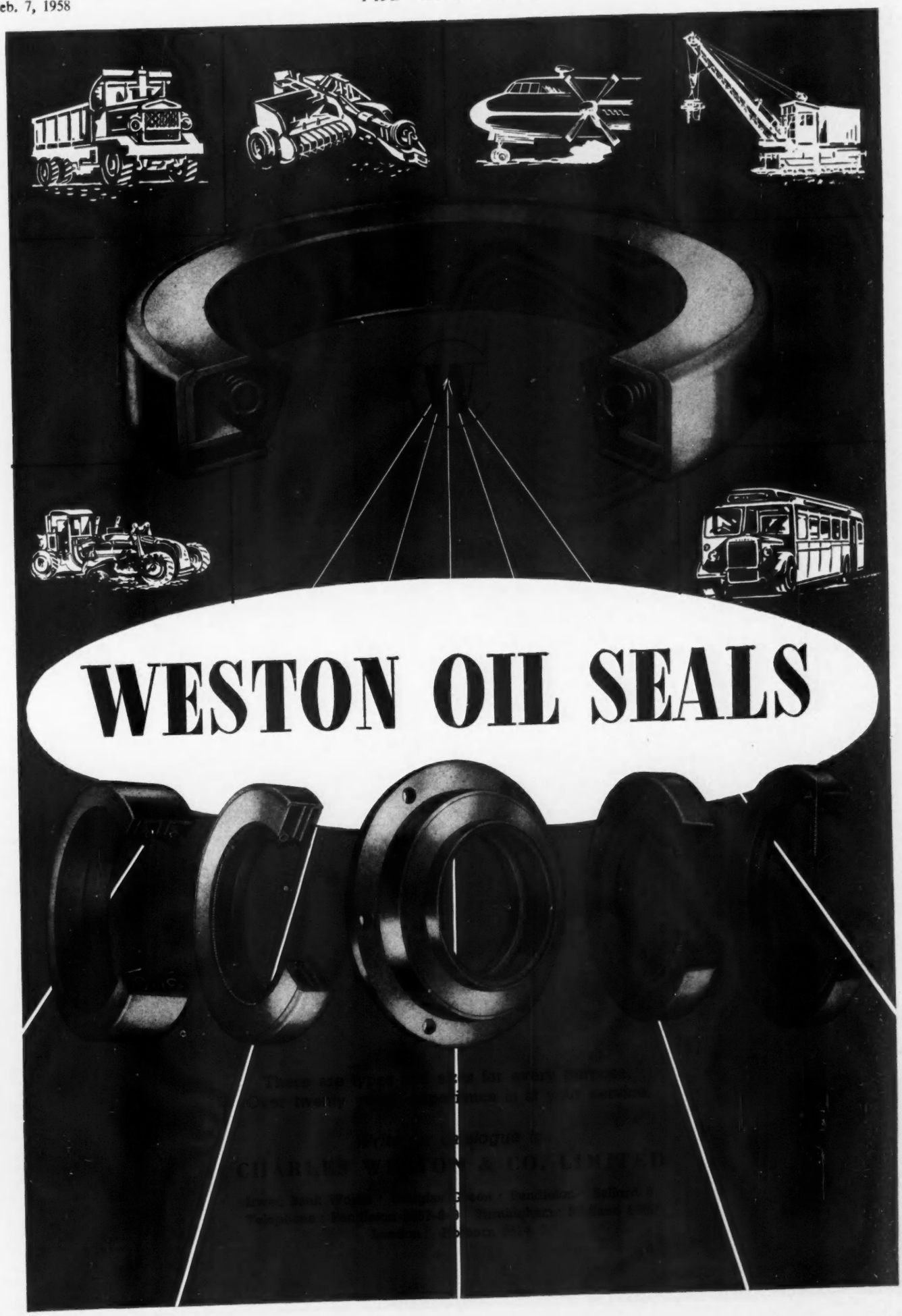
The John Thompson system of hydraulic ash disposal provides a clean and efficient method of ash and dust conveying of unlimited capacity. Hydraulic ash disposal has been applied successfully to both small shell boiler plants and to large water tube boiler installations with ratings of millions of pounds per hour evaporation employed in modern power stations. Boiler plant refuse may be piped to waste land or disused quarries by this method, or stored in sumps for final disposal. The illustration shows the Central Electricity Authority's Carmarthen Bay power station, where residues from a 3,600,000 pounds per hour boiler plant are handled by this system



**JOHN THOMPSON INDUSTRIAL CONSTRUCTIONS LIMITED**
(Formerly B.V.C. Industrial Constructions Ltd.)
**2 PRINCES ROW, BUCKINGHAM PALACE ROAD., LONDON S.W.1.**
*Telephone*: VICtoria 9312. *Telegrams*: Induscon, Sowest, London. *Cables*: Induscon, London.

JOHN THOMPSON GROUP

ICH/2


WESTON OIL SEALS

# Are you Interested in HARD SURFACING ?

. . . then send for these samples of

**Danelle**

hard surfacing rod

*and discover for yourself the fastest and most successful form of Hard Surfacing*

**DANITE HARD METALS LTD., CARR HILL, DONCASTER**
*Phone: Doncaster 2294/5 & 4010 (10 lines)*

*Please send descriptive literature and samples to:*

NAME.....

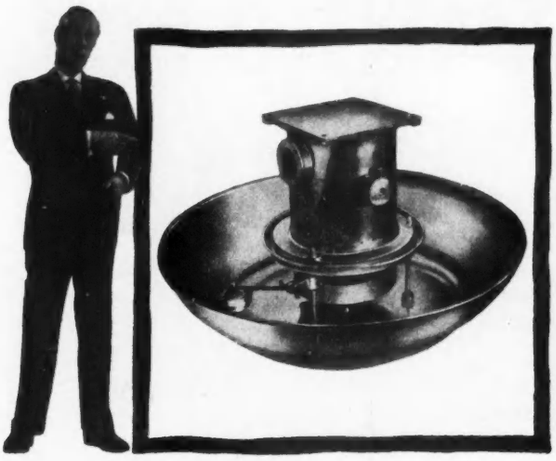
POSITION HELD .....

COMPANY .....

ADDRESS.....

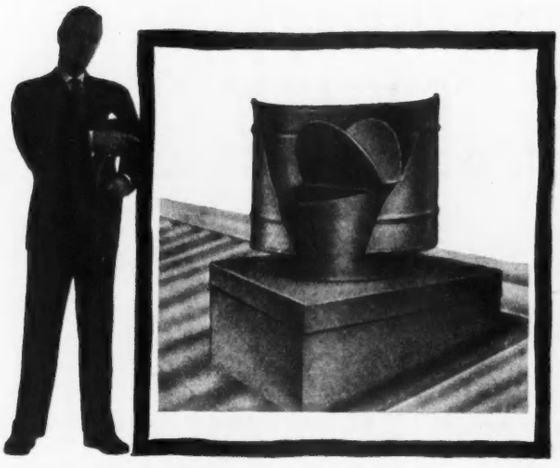
M-W.58

# Do you KNOW?



## THE AEROSOL-TURBO?

—a new humidifier which has already proved of immense value to many industries from Textiles to Tobacco. The Aerosol-Turbo gives trouble-free, controlled humidification, without wetting or water tracking. May we demonstrate this machine at your premises?



## THE UPBLAST?

—an 'all-year-round' roof unit—the most powerful ventilator ever devised for the dispersal of fumes and vitiated air. Air movements range from 2,000 to 27,000 cu. ft. per minute. When not in use, the automatic stainless steel shutters keep valuable heat in and the elements out. Full details are available on request.

**Do you know that Walkers are here to solve all your air treatment problems?**

MADE IN BRITAIN

## P M WALKER & CO

**(HALIFAX) LTD**

Alexandra Works Hopwood Lane
Halifax Tel: 60346 (5 lines).

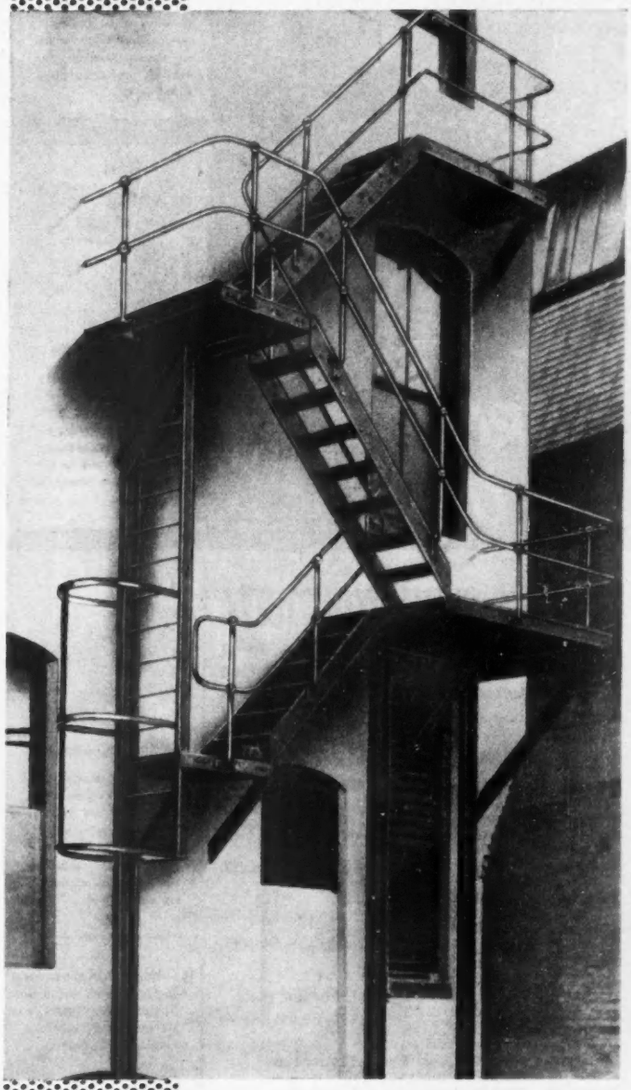
Manchester Royal Exchange
Pillar C 9 Fridays

P M WALKER

WE DESIGN AND BUILD

## Staircases & Handrailing

IN STEEL OR ALUMINIUM ALLOY



STEELWAY LIMITED
WOLVERHAMPTON

*Fully illustrated catalogue free on request*

FIRE ESCAPES
ACCESS LADDERS
OPEN TYPE FLOORING
PATENT 'PROMINEDGE' STAIR TREADS
CHEQUER PLATE FLOORING
CHEQUER PLATE STAIR TREADS
PLATFORMS & WALKWAYS

QUEENSGATE WORKS, WOLVERHAMPTON
LONDON OFFICE: TEL: 21633 (2 lines)
25, HANOVER SQUARE, LONDON, W.1. PHONE: MAYFAIR 8783-8788

BLACK & DECKER — THE TOOLS FOR EVERY INDUSTRY

PROVED ON SITE

**7" SANDER-GRINDER**

A heavy duty model, invaluable for continuous production work. Easy to handle, with immense power. Makes light work of metal cleaning, de-rusting, tool-sharpening, grinding etc.

**½" H.D. HOLGUN**

One of 16 drills available, ranging from ¼" H.D. Holgun to 1½" H.D. Drill. Ideal for construction, assembly, maintenance and repair work in any material from wood to steel.

## WE CAN SHOW YOU HOW

A demonstration, without obligation, under your own site conditions will convince you that Black & Decker tools can effect tremendous savings in time and labour in your business.

Send coupon or telephone to
**BLACK & DECKER LIMITED**
**HARMONDSWORTH, MIDDX.** West Drayton 2681/9
— or your nearest branch

| | |
|---|---|
| **Birmingham** | Crompton Road, Long Acre, Birmingham 7. Phone: East 3411/2. |
| **Bristol** | 29 Broad Street, Bristol 1. Phone: Bristol 25781. |
| **Glasgow** | 126 North Street, Glasgow, C.3. Phone: Glasgow City 7195. |
| **Leeds** | 13 Greek Street, Leeds. Phone: Leeds 34361. |
| **London** | 378/380 Holloway Road, London, N.7. Phone: North 3256. |
| **Manchester** | Knott Mill, Manchester, 15. Phone: Blackfriars 8865. |
| **Nottingham** | 27/31 Wollaton Street, Nottingham. Phone: Nottingham 47333. |
| **Newcastle** | 126/128 Heaton Road, Newcastle. Phone: Newcastle 655710 and 656700. |

NAME .....

ADDRESS .....

.....

.....

BUSINESS .....

* *I am interested in a demonstration of the following tool(s)* .....

No. 107 H

**10" BENCH GRINDER**

6", 7", & 8" models also available. Powered by constant speed motors and adaptable for buffing, wire wheel brushing, grinding and tool-sharpening. Pedestal mountings can be supplied.

* Other tools in the range include Saws, Orbital Sanders, Shears, Screwdrivers, Valve Refacers and Valve Seat Grinders, Hammers.

***USERS TECHNICAL ADVISORY SERVICE***

For free advice and assistance on the operation and application of Electric Tools, write to the Users Advisory Service, Black & Decker Ltd., Harmondsworth, Middx.

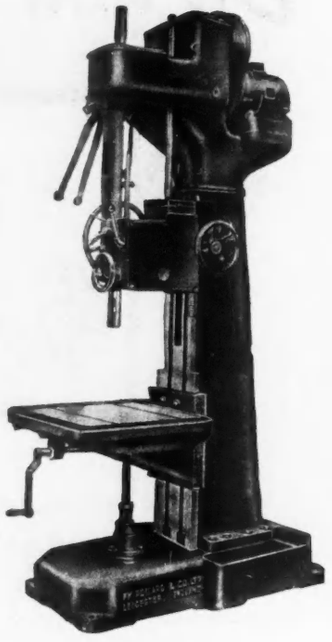
Black & Decker
ELECTRIC TOOLS

Issue's I.A. 20



CORONA

## GENERAL PURPOSE
## UPRIGHT DRILLING MACHINES



THREE SIZES
21"—25"—28" Swing
1¼"—1½"—2" Drill Capacity

Box Column and Round Column Models in each size

Nine Spindle Speeds
Variable Automatic Feed

Box Column Models supplied in Gang Drill Form

**FREDK. POLLARD & CO. LTD.,**
**CORONA WORKS, LEICESTER**
**ENGLAND**

Telephone *Leicester 67534 (5 lines)*

Telegrams *"Corona" Leicester*

LONDON OFFICE: Coastal Chambers, 15 Elizabeth St., Buckingham Palace Road, S.W.1



If it doesn't—*it can't be*

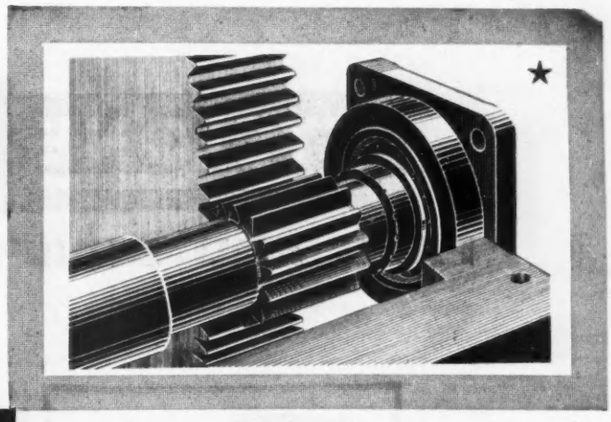
it can't be a genuine *Jubilee* CLIP
REGD TRADE MARK

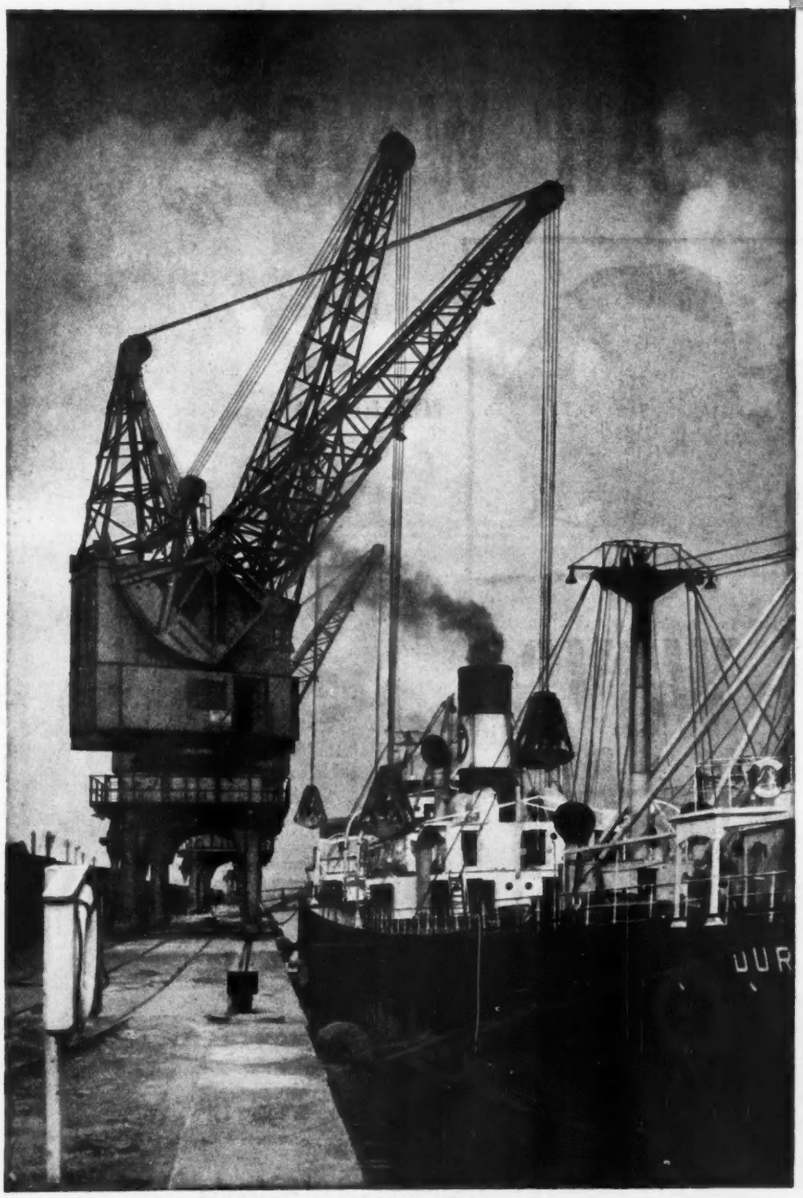
*Famous in Four Reigns*

L. ROBINSON & CO. (GILLINGHAM) LTD., LONDON CHAMBERS, GILLINGHAM KENT., TELEPHONE 5282

**Serving transport and Industry**

# CLYDE-BOOTH Cranes





*Clyde 7½ ton Level Luffing Cranes at work on the Manchester Ship Canal.*

## Salient Features of Clyde-Booth Design . . .

### GEARS & BEARINGS ★

Designed for long life and quiet operation and made from high grade materials, Clyde-Booth gears and bearings have these advantages:

- **Pinions solid with shafts ensures concentricity and eliminates keys.**
- **Accurately cut involute gear teeth with corrected form where necessary to avoid undercutting.**
- **Gears mounted on short stiff shafts eliminates deflection.**
- **Gear tooth velocities kept low.**
- **Roller bearings mounted in cartridge housings facilitates inspection and maintenance.**
- **Cartridge housings carried in steel slab gear box side members ensure fixed gear centres and maintain correct alignment.**

**CLYDE CRANE & BOOTH LTD.**

*Incorporating :*

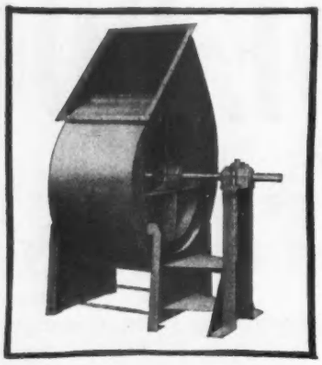
**Joseph Booth & Bros.,**
*Union Crane Works, RODLEY, Leeds.*
*Telephone: Pudsey 3168 (6 lines).*
*Telegrams: "Cranes," Rodley.*

**Clyde Crane & Engineering Co.,**
*MOSSEND, Lanarkshire.*
*Telephone: Holytown 412 (6 lines).*
*Telegrams: "Clyde," Motherwell.*

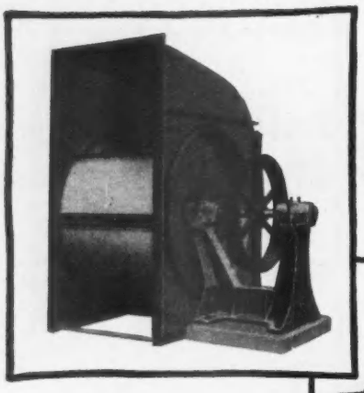
CLYDE BOOTH

# CYCLONE

## FANS AND EQUIPMENT

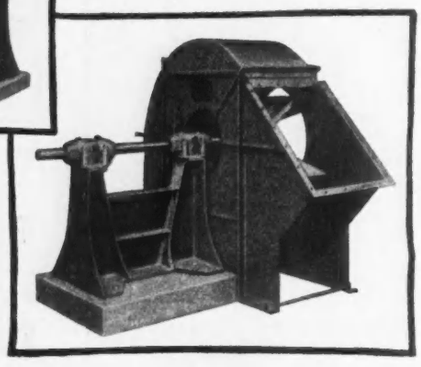


SLOW SPEED MULTIVANE FAN (Intermediate size).



SLOW SPEED MULTIVANE FAN (Large size).

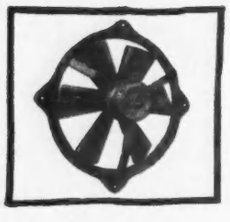
# Air ways



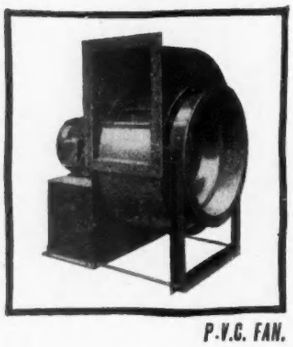
PADDLE BLADE FAN.

# are our ways

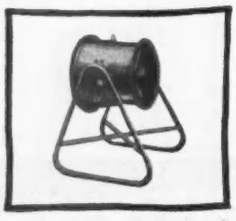
AXIAL FLOW FAN.



PROPELLER FAN.



P.V.C. FAN.



MAN COOLER FAN.

Ventilation, dust collection, fume removal and cooling industrial "hot spots" are jobs for Cyclone Fans and Allied Equipment.
75 years' experience, technical advice and comprehensive literature is yours on request.

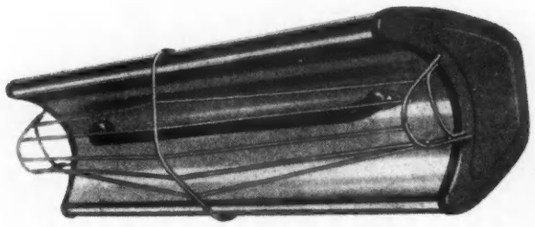
**MATTHEWS & YATES LTD.**

CYCLONE WORKS · SWINTON (MANCHESTER)
TELEPHONE: SWINTON 2273 (4 lines)

& 135 RYE LANE, PECKHAM, LONDON S.E.15
TELEPHONE: NEW CROSS 6571 (4 lines)

*Also at: Glasgow · Leeds · Birmingham · Cardiff · Bournemouth*

9026



"Saferod"

No worries! Just safe gentle warmth. For bathrooms, nurseries, entrance halls, consulting rooms, anywhere in fact. The fullest protection is achieved as all live parts are totally enclosed. The 'SAFEROD' is easily fitted, economical, attractive, durable, efficient and absolutely safe.

*Send for leaflet No. 87*

high level safety heater

Heatrae

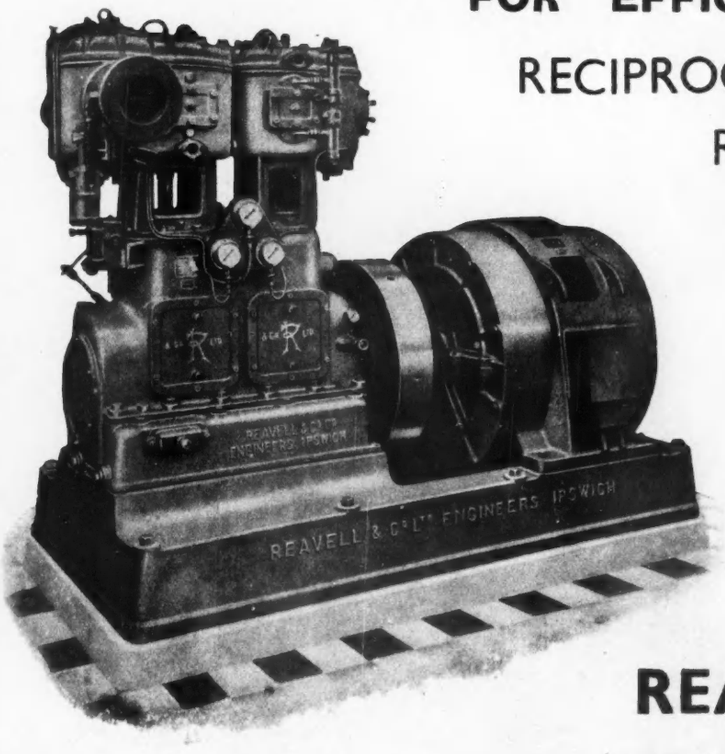
Manufacturers of Electric Water Heaters, Oil Heaters, Immersion Heaters, Urns, Towel Rails, Airing Cupboard Heaters, Flameproof Heating Apparatus, Breakfast Cookers, Electric Fires, Food Trolleys, Warming Plates, Air Heaters, etc.

*Established in 1920*

HEATRAE LIMITED · NORWICH

*SPECIFY* "REAVELL"

FOR EFFICIENCY AND RELIABILITY




RECIPROCATING COMPRESSORS
ROTARY COMPRESSORS
TURBO COMPRESSORS

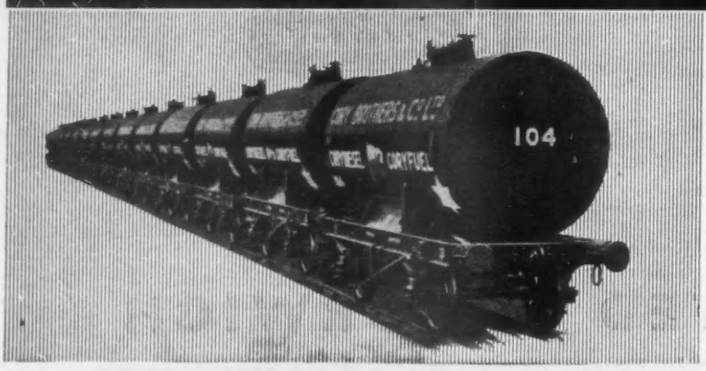
PRESSURES FROM
1 TO 10,000
LBS. PER SQ. INCH

FOR AIR, HYDROGEN, OXYGEN, NITROGEN, AND OTHER GASES.

REAVELL & CO. LTD.
IPSWICH, ENGLAND
Telegrams: "REAVELL" Ipswich Telephone: Ipswich 56124 (3 lines).

# Storage and transport of liquids . . .

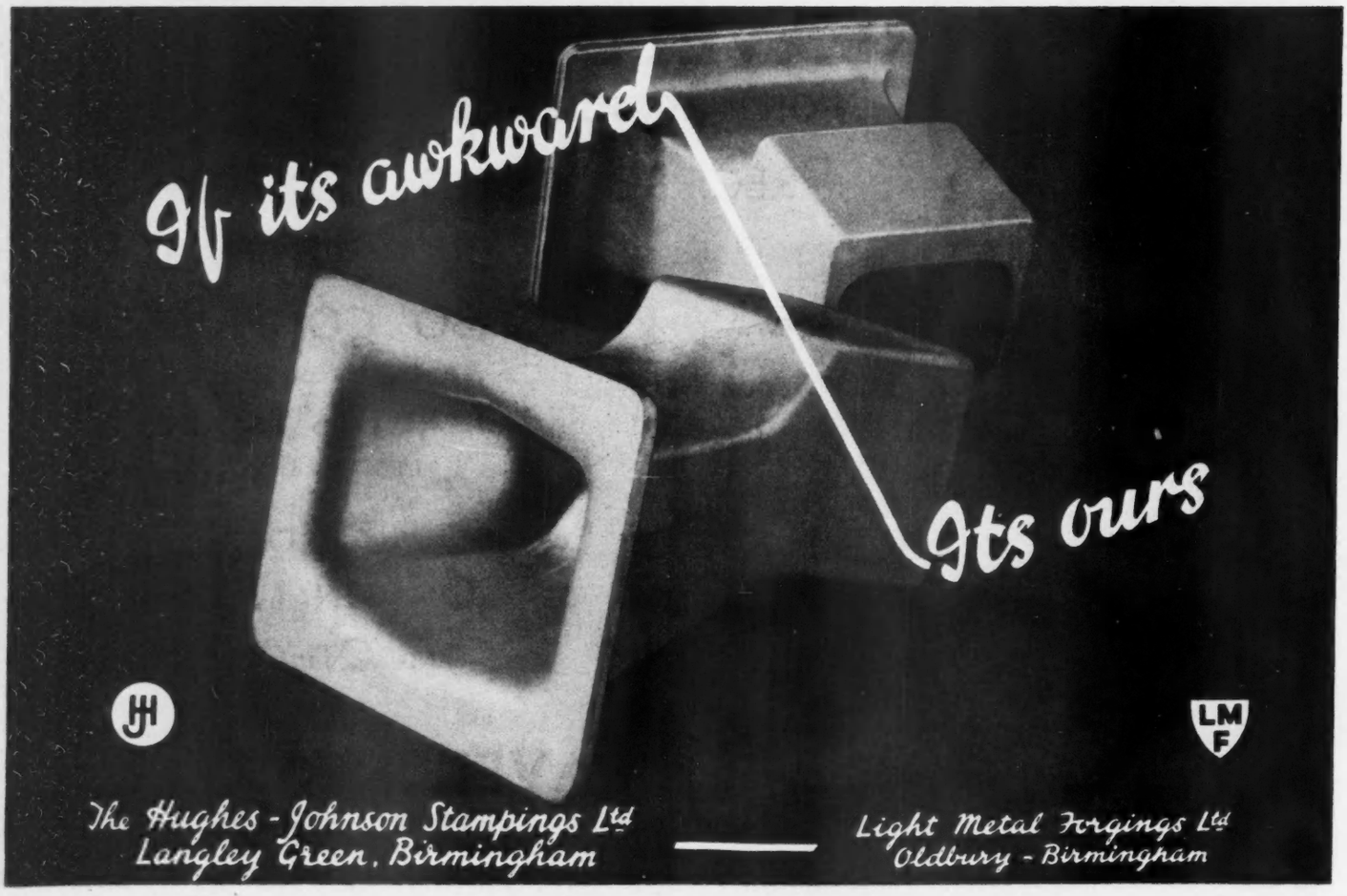
## CAMBRIAN WAGON & ENGINEERING COMPANY LTD.




- **Storage tanks of all capacities**
- **Rail and Road Tankers**

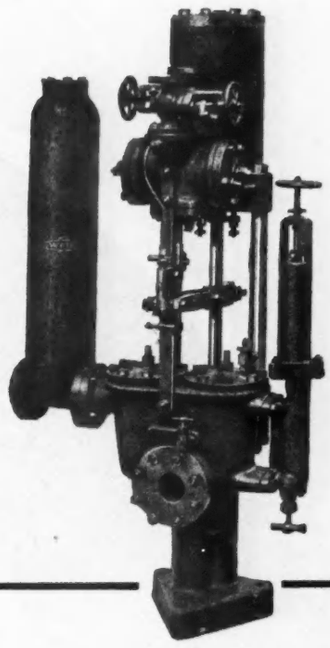
CAMBRIAN are especially equipped to supply the increasing needs of industry for the storage and transport of all types of liquids.

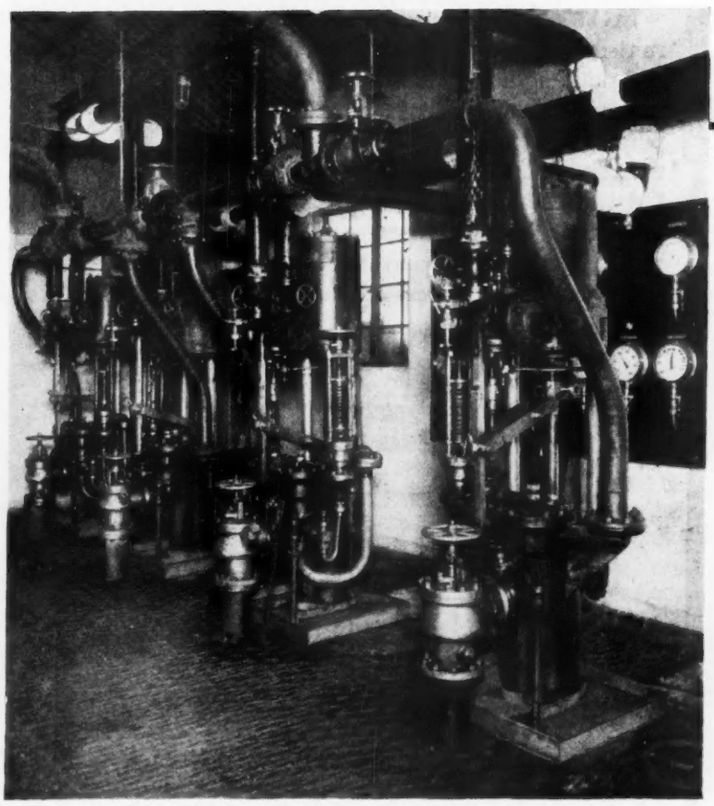
**CAMBRIAN WAGON & ENGINEERING COMPANY LTD.**
**MAINDY · CARDIFF**
Telephone: Cardiff 29611 (6 lines) Telegrams: Wagons, Cardiff



# Weir

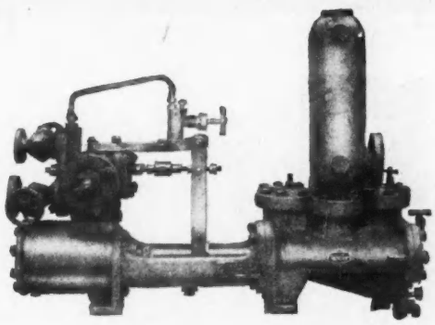
# OIL FUEL PRESSURE PUMPS





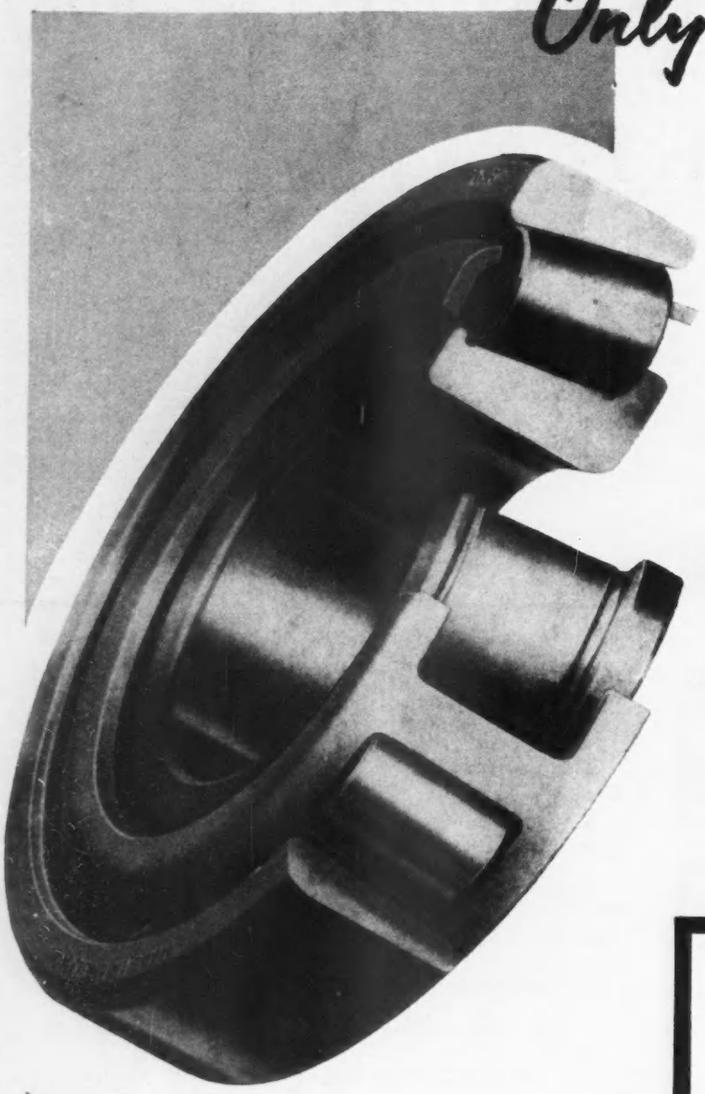
**are made in vertical and horizontal designs with single steam cylinder and double-acting oil end, and are specially suitable for pumping the heaviest and most viscous qualities of fuel oil. The Weir Piston Valve Chest ensures certainty of action and economical working.**

**Weir Oil Fuel Pressure and Transfer Pumps and Forced Lubrication Pumps are supplied in standard sizes and capacities.**



G. & J. WEIR LTD
CATHCART : GLASGOW

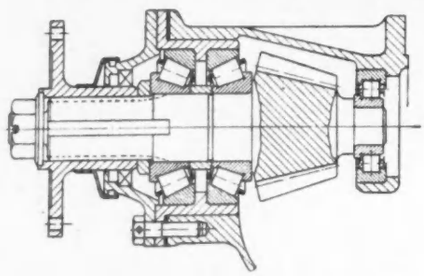
*Weir Products include:*
FEED PUMPS · FEED HEATERS · FEED REGULATORS · EVAPORATING & DISTILLING PLANTS · DEAERATORS



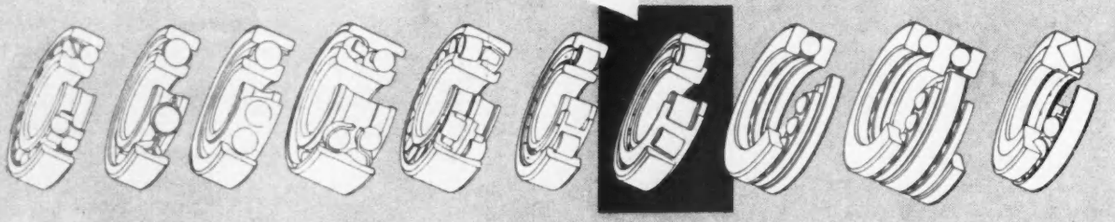
# Only SKF *can offer such a wide selection of British made bearings*

Taper roller bearings to both inch and metric dimensions, form part of the unique range of ball and roller bearings manufactured by The Skefko Ball Bearing Co. Ltd.

In SKF taper roller bearings the rollers run smoothly and freely under load, all skewing and skidding being eliminated. Many important improvements in roller bearing design have been pioneered by the world-wide SKF Organisation, and in this country The Skefko Ball Bearing Co. Ltd., as the only British manufacturer of all four basic bearing types—the ball, cylindrical roller, taper roller and spherical roller—can offer completely unbiassed advice on all your bearing problems.



*A straddle-mounted bevel pinion for a commercial vehicle incorporating two taper roller bearings and one cylindrical roller bearing*



THE SKEFKO BALL BEARING COMPANY LIMITED · LUTON · BEDS

THE ONLY BRITISH MANUFACTURER OF ALL FOUR BASIC BEARING TYPES: BALL, CYLINDRICAL ROLLER, TAPER ROLLER AND SPHERICAL ROLLER

G 171

# THE ENGINEER

No. 5324 FEBRUARY 7, 1958 VOL. 205

## " EXPLORER " IN ORBIT

The Americans took it so much to heart when the Russians proved to be first in the field in setting up an artificial satellite of the earth that it is with a substantial sense of relief, as well as with much pleasure, that we can now congratulate them on their own fine technical achievement in placing their satellite, named " Explorer," in an orbit. The " Explorer " started to circle the earth last Friday night. Its orbit, according to accounts at present available, lies somewhat further out than those of either of the Russian " Sputniks." A circuit is made about every 115 minutes. Perigee is some 200 miles above the earth's surface (230 miles and 186 miles have both been mentioned), and the eccentricity is quite pronounced as apogee is some 1700 miles or more above the earth's surface. The object weighs 30·8 lb, is pencil shaped, and is 80in long. It includes the burnt-out third stage rocket and it carries some 11 lb of instruments in its head. Comparisons are always odious, but, nevertheless, they need to be made. The second " Sputnik," also a burnt-out last stage, weighs almost half a ton. The " Explorer's " orbit is more nearly equatorial than that of the Russian " Sputniks," the highest latitude reached being about 40 deg. There are two radio transmitters, one operating on a frequency of 108 megacycles, the other on 108·3. They have powers very substantially less than those of the transmitters on the " Sputniks," but they are designed to operate for a longer period and the less powerful of the two is expected to be still working up to three months from now. It is believed that information about temperature, cosmic rays and the amount of cosmic dust colliding with the object will be signalled back to earth. The orbit of the satellite and its instrumentation are " made to measure " to suit the chain of visual and radio-watching stations set up in the United States, and elsewhere, in connection with the " Vanguard " project. That latter project, under which a sphere some 20in in diameter and carrying 20 lb of instruments, was to have been the first earth satellite set up by man, is still under development and is likely to come to fruition, as originally planned, some time this year.

The evidence is strong that " Explorer " has been set in its orbit for reasons of prestige above all others. Had the Russians not placed their " Sputniks " in orbits last year the " Vanguard " project would have been continued and no special effort would have been made to accelerate the programme. Forced by the emotional reaction of the American people, however, the U.S. Administration seems to have given instructions that, somehow or anyhow, an American satellite must be set up at the earliest possible date. The U.S. Army had in being at least one tested ballistic missile powerful enough to act as the first stage in setting up an earth satellite. Inter-service rivalry, no doubt, added to Army keenness to undertake the task. For just over two years ago a Defence Ministry directive laid it down that the responsibility for the development of all land-fired missiles with a greater range than about 200 miles should lie with the Air Force, which preferred its own missile, the " Thor," to the " Jupiter," although, in fact, development of both weapons was continued. It appears to have been a modified version of the " Jupiter C," a multi-stage member of the " Jupiter " series, which put the " Explorer " into its orbit, using apparently what rocket engineers term an " exotic " propellant, though such a propellant is not, we believe, normally used in " Jupiter " rockets. That adequate instrumentation could be fitted into a last-stage rocket, whose shape differed substantially from the " Vanguard " spherical container for which instruments were no doubt initially designed, indicates that the Americans are well advanced in the design of miniature instruments.

In fact, it appears obvious that the " Explorer " has been flung into an orbit at the cost of diverging from the planned programme of development of the " Jupiter " series of ballistic test vehicles. American jubilation, therefore, though very understandable, seems to us somewhat misconceived. For if there was a political motive behind the Russians' demonstration of their power to set up " Sputniks " it was to give notice to the world that they had developed a successful intercontinental ballistic missile. It is a fine feat on the part of the Americans to have put the " Explorer " into an orbit. But it has in no sense demonstrated that American rocket development has caught up with that of the Russians and it may even mean that the routine development of the " Jupiter " for its true purpose as an intermediate range missile has been delayed. Very probably the thoughts and energies of those developing the " Thor " have also been diverted and possibly the well-thought-out " Vanguard " programme, whose second test vehicle was fired unsuccessfully on Wednesday, has been delayed. Considering the limited means available the setting up of " Explorer " in its orbit is a particularly fine technical achievement. Scientifically, it will help largely to increase man's knowledge. But diplomatically it has changed the situation not one whit.

## TOWNS' WASTE AND DERELICT LAND

In this island the population is so dense that only about half our food can be produced at home. What justification is there, then, for allowing large acreages to remain derelict and unproductive ? How much expenditure from the public purse is justified to bring derelict land into use ? The current *Journal* of the Royal Society of Arts contains the proceedings of a conference at which one of the subjects discussed was " The Reclamation of Land Disfigured by Industrial Use." Some useful facts were given by the various contributors to this conference. Derelict land in England and Wales was estimated to be at least 126,000 acres, and disfigurement was going on at a rate of about 3000 acres a year, it was stated. In

Lancashire the problem was particularly acute, with 4000 acres of derelict land and the prospect that there would be as much dereliction in the next twenty years as in the past hundred. A few pilot schemes had been carried out, but reclamation needed to be tackled on a big scale, it was considered, with far more finance behind it. A reclamation scheme could be justified on grounds of land conservation alone if it cost about £200 per acre (the cost of replacing the output of an acre of average agricultural land), but little would be done, according to Mr. U. A. Coates, the county planning officer of Lancashire, on that basis, since the value of reclamation could not be measured in terms of cost alone.

The disposal of waste materials from industry and from towns is closely related to this problem of derelict land. Disposal may be an appreciable charge on the community or industry, but by using these materials for reclamation there is obvious potentiality for doing both jobs more economically. This point of view was apparent at the meeting at the Institution of Civil Engineers on January 28, when a discussion on the "Disposal of Towns' Wastes" took place, introduced by four short papers. A more promising attitude to the economics of reclaiming derelict land was taken by Mr. R. M. Finch, the city surveyor of Nottingham, who referred to recent achievements in Nottingham where waste land had been reclaimed virtually at no cost at all. He proposed that as a basis for future work of this kind, a national survey of derelict land was essential ; further, he considered that national legislation should be introduced stipulating that a "developer" of any kind should replace every acre taken from agricultural use by reclamation of an acre of derelict land, which could be done without excessive burden of cost.

The value of refuse and sewage sludge as fertilisers also figured prominently in this discussion. One of the most promising processes appears to be the composting of the organic content of refuse with sewage sludge. The composting process is a natural one, and proceeds on its own, provided temperature, aeration and moisture are correctly controlled ; further, the temperatures attained result in sterilisation of the product. The compost which results is not so good as farmyard manure —in particular it is deficient in potassium—and those qualities which may give it advantage over inorganic fertilisers, namely improvement of soil structure and provision of trace elements, have not been assessed with any exactitude. Nevertheless the process will probably be introduced more widely by local authorities. One of the drawbacks is the uncertainty of a market for the compost. Perhaps by "topping up" the compost with inorganic fertilisers, especially potash, sales would be promoted. But even if composting of household refuse became nation wide, the figures given indicated that a relatively small contribution of fertiliser would result—about 2 per cent of the farmyard manure now used—and only a fraction of the sewage sludge available would be used up in this way. The explanation of this small—though maybe not insignificant—contribution appeared from figures given during tne course of the discussion. Of the main plant nutrients (i.e. containing phosphorus, nitrogen and potassium respectively) contained in sewage, the great bulk of each, and especially of the more soluble potassium compounds, is present in the liquid fraction, and not much is left in the sludge. This would appear to indicate that a long term research into some novel approach to sewage treatment which made possible the utilisation of the nutrients in the liquid fraction might eventually prove of considerable benefit.

## THE DAGENHAM RAILWAY COLLISION

Ten people lost their lives and eighty-seven were injured in a collision which occurred between Dagenham Heathway and Dagenham East stations on the Eastern Region of British Railways on Thursday evening, January 30. The accident occurred in a very thick fog when a steam locomotive hauling the 6.35 p.m. Fenchurch Street to Shoeburyness train ran, tender first, into the rear of the 6.20 p.m. Fenchurch Street to Southend train on the same line. The engine of the 6.35 p.m. train was derailed and is stated to have ploughed halfway through the rear coach of the preceding train.

The section of line upon which the accident took place is equipped with the Hudd or (London, Tilbury and Southend) system of automatic train control. This system, it may be recalled, is operated by magnetic induction and uses two track fittings—a permanent magnet and an electro-magnet—and a receiver on the locomotive, which incorporates means of audible and visual warning and brake-applying mechanisms. The electro-magnet in the track is energised when a signal is at clear and de-energised when it is set at caution. When approaching a signal the locomotive first passes over the permanent magnet in the track and this energises an electro-magnet in the receiving apparatus, which operates an air valve through which a horn is sounded a few seconds before air is admitted to the train brake line. If the signal is clear the energised electro-magnet, situated a short distance further along the track, automatically recloses the air valve through its electro-magnet to stop the horn blowing and prevent application of the train brakes. Thus, the driver is given brief audible notice that he has passed a signal at clear. If, however, the signal is at caution when the locomotive passes the equipment, the electro-magnet in the track does not come into effect, the horn continues blowing and the train brakes are applied. When this occurs, the driver can cancel the effect of the automatic equipment by operation of a lever on a resetting equipment, and when this resetting lever is operated a black disc on the equipment turns to show black and yellow.

The record of safety on British Railways, considering the density of traffic, is second to none in the world, and this probably arouses far greater concern, in that the accident at Dagenham should be the second with such serious consequences in less than two months. It has brought the whole question of safety to the fore. It has also emphasised the fact that automatic train control acts as an aid to the driver, and not as an absolute preventive of collisions, as the lay public sometimes seems to think. The actual cause of the Dagenham disaster, and whether the warning equipment was operative or not, will be elucidated at the official inquiry—the results of which we cannot at present anticipate.

## "TURBOPROPTOSIS"

It is, apparently, still possible to believe in the future of the aircraft industry of this country. Not only are there organisations still hopefully tendering proposals to build aircraft for which the market is no more than speculative, but Sir George Edwards, president of the Royal Aeronautical Society, was optimistic when he spoke in New York on Thursday last week. A part of the evidence adduced by Sir George in support of his optimism was the unique British experience of jet airliners. But his subsequent reference to the use of similar aircraft by armed forces, of course, drew attention to the similar advantage

enjoyed by United States constructors of jet transports.

But although Sir George's faith in turboprop transport has lasted from 1949, the prospects of the propeller turbine were darkened abruptly the very day after he made his speech when the Bristol Aeroplane Company revealed its decision not to continue the development of the "Orion" "supercharged" engine after the termination of support from the Ministry of Supply. We do not believe that the company lost faith in the prospects of that particular engine; for it enjoyed the immense advantage of being without a direct competitor and, being a "good big 'un" rather than a clever little engine, should not have had an unpredictably protracted gestation. The decision appears to be based on the belief that the next generation of turbo-prop aircraft are not going to materialise, at least in numbers adequate to justify an engine support programme. It has seldom been denied that the principal claim for the propeller-driven transport, economy, is an insufficient advantage unless a fare differential between jet and prop-jet aircraft is introduced. While a fare structure has yet to be established, it is probably the conviction that no concession can be expected that has forced the Bristol Company to abandon a form of propulsion which has undisputed practical advantages. There can be no doubt that the expressed regret of the company is genuine. While it is true that its jet engines enjoy the flattery of production under licence in the United States of America, that country is accumulating experience of compound engines many times faster than is Britain, and any leadership we may have in gas turbine technology can hardly be expected to endure very long. The decision even seems to mean that the development life of the "Britannia" will be substantially shorter than expected, and it is quite clear that the "400" series is lagging far behind its German prototype in development. While one example rarely commands credence, it is surely not a coincidence that both Saunders-Roe, proponents of the commercial flying boat, and Bristol have been forced to face a somewhat uncertain future, not because of their own failures, but because this country has not brought into being the forms of international transport that would advantage it most.

## THE STATE OF SHIPBUILDING

In a leading article "Shipbuilding Challenge," which was published in THE ENGINEER of March 15 last year, we commented upon the strong challenge being made by Japan to wrest from this country the position of being the leading shipbuilder. Indeed, the returns for 1956 showed that in the commenced, launched and completed tonnage groups, Japanese yards had passed the corresponding British totals by margins of varying amount. Only in the less important category of tonnage under construction did this country maintain a lead. Consideration of the figures for 1956 in relation to those of 1955 predicted that, in the tonnage in the three main groupings, Japan would go further ahead, and the trend thus indicated is confirmed by the returns for the fourth quarter of 1957 recently issued by Lloyd's Register of Shipping. The tonnages commenced, launched and completed amounted to 2,518,000, 2,424,000 and 2,309,000 tons gross respectively, while the corresponding totals for Great Britain were 1,597,000, 1,407,000 and 1,421,000 tons gross. Thus, in each group Japan now leads by a margin, which is very little short of 1,000,000 tons, so that, even if the British industry received all the steel it required and achieved its estimated maximum output of about 1,750,000 tons, Japan would still lead by a comfortable margin. These results confirm Japan as the leading shipbuilding country in the world.

Turning aside from the limitations imposed by the availability of steel, both as regards tonnage and delivery sequence, matters which can only be rectified by the steel industry itself, there is ample evidence that the construction of ships could be speeded up in this country. The short time to build a ship recently announced by a Sunderland yard, although perhaps an isolated case, was achieved and so must be considered as a pointer to what is possible of achievement elsewhere, given co-operation between management and labour. The high speed at which ships are built in Japanese yards is a measure of the value of extended and detailed planning, coupled with the adoption of modern techniques. Tradition dies hard, so that there is a reluctance to exchange new skills for old, or even to give recognition to new skills; nevertheless, new materials and new methods are with us and the fighting of rearguard actions in defence of the old ways and relationships only delays the inevitable and weakens the potential and competitive strength of British shipbuilding. The course which was held in Glasgow recently, and attended by directors and shipyard managers, for the study of the application of the latest management methods to shipbuilding is a step towards a co-ordinated study of the possibilities of production planning and its effect on overall efficiency. The arrangements were made by Production Engineering, Ltd., and perhaps courses suitable for other sections of the industry can be compiled so that modern ideas regarding work study and planning will become more familiar, understood and accepted: perhaps, in time, instead of management and labour taking opposite sides, they will act as a team with beneficial effect upon productivity, cost efficiency and working conditions throughout the shipbuilding industry.

## The Engineer — 100 Years Ago (FEBRUARY 5, 1858)

"PUBLIC CONVEYANCES"

"We have, in common with many of our contemporaries, spoken, on several occasions, and that in no measured terms, of the miserable accommodation afforded in our public conveyances. We have pointed out how wide, how long, and how high our omnibuses should be, if the comfort of passengers is to be regarded, and we have proved to all, except omnibus proprietors and builders, how increased length, breadth and height may easily be obtained, with a very small increase of weight—so small, as to render it a matter of no importance as regards the draught of the vehicles . . .

"The boasted promises with which the London General Omnibus Company started have turned out a perfect sham—no single improvement having been effected, if we except the system of correspondence, which has only very partially been carried out, and which ceases to be operative after, we believe, nine o'clock at night. Nine out of ten of the omnibuses in use, notwithstanding the company must have built some hundreds since commencing operations, are exactly of the old type—narrow, low, short, and ill ventilated, darkness being just rendered visible at night by the smallest possible lights, in wretched looking lamps with cracked glasses, the oil being apparently of little better than the worst kind, and not infrequently emitting fumes which pervade all parts of the vehicles, and which no amount of ventilation can remove. . . . The real fact is, omnibus designers have generally attempted to accomplish two objects, which have proved to be quite incompatible with each other, the first being to make real improvements upon the old type of vehicles, and the second, to do this without in any way altering their form or general structure, which they have justly considered would operate against their introduction amongst old omnibus proprietors."

# Training of Craftsmen

By PROFESSOR LADY WILLIAMS

No. II—( *Concluded from page* 167, *January* 31 )

*In the first part of this article Lady Williams examined the origins of apprenticeships and discussed their defects. Modern apprenticeships began in an attempt by the nineteenth century unions to protect their members from the challenge of the machine, and they have remained virtually unchanged despite their shortcomings as means of inculcating particular skills.*

LEAVING aside for a time the question of numbers, what of the apprenticeship schemes themselves? Do they provide training as effectively and as economically as possible? It is unwise to generalise in so large a matter, but there are certain features that lead one to doubt.

The first and most striking is that all the schemes are so similar in pattern and one cannot help wondering how it happens that all skilled jobs, whatever the nature of the work, take exactly five years to learn. It is obvious that the period has been fixed with some other objective in mind than simply assuring a thorough training ; and this is, indeed, the case. The unions insist on five years in order to maintain a clear line of demarcation between those allowed to do the jobs and " outsiders," with the added hope that this lengthy period will keep down the numbers in the trade. The employers accept it because they hope to compensate themselves to a certain extent during the last couple of years of the apprentice's " time " for the losses incurred by the small amount of marketable product he produces in the earlier part of his training. Neither side would maintain that, in general, it takes as much as five years to learn the trade.

Closely associated with this rigidity in the length of training are two other features—the lack of any actual instruction and the lack of any test of competence at the completion of the apprenticeship. Something must be said about each of these.

Many firms devote an immense amount of care and thought to the planning of the apprentice's progress through the works in order to ensure that he gains an all round knowledge of the craft to which he is attached. Many, in addition, have works schools and induction courses in which he is introduced to the general layout of the firm and becomes familiar with the tools and materials he will use in his job. But once he is moved out into the shops this careful instruction ceases. Nobody teaches him what to do or how to do it nor what snags to avoid. It is assumed that he will pick up his knowledge by watching others and copying what they do.

All the schemes to which reference has been made laid great emphasis on the importance of sound teaching. They urged apprentice supervisors to take care in the selection of the craftsmen in whose charge the apprentice was to be put and see that they were not only thoroughly skilled in the job, but also that they had the sympathetic understanding of the young, which would enable them to see their difficulties and help them to overcome them. But it does not work out that way ; and those who put such clauses into the schemes might have known it would not, had they been willing to face realities instead of indulging in fantasies. It is always difficult to find men who are both good craftsmen and good teachers and, when they are found, it is asking a great deal of them to expect them to turn aside from their own work, with consequent drop in earnings, to explain what they are doing and why they are doing it to a youngster. Some firms try to get over this problem by making a small payment to the craftsman to compensate him for his loss of time, but such payments are rarely more than token amounts. The harassed foreman who discovers a kindly and sensible worker to act as " teacher " to an apprentice feels that he dare not be so unjust as to saddle him with a constant stream of " learners " and perforce puts the next boy in the nominal care of men who are anxious to get on with their own jobs and do no more than give an occasional glance or word of advice to the apprentice. Thus it happens that whilst the administrative set-up of the training scheme is often admirable, there is practically no actual teaching given to the young trainee at all. A boy learns to do a good job if he is observant, quick in the uptake and has the luck to be with really efficient men and the opposite if he is not.

Surprisingly, the fact that he may learn bad methods does not prevent him from becoming a qualified worker, for there is absolutely no test of competence. All that is required is that he spends the prescribed period in training ; but whether he learns anything during that time, or what he learns, is not questioned. Having reached the age of twenty-one and having spent five years as an apprentice, he is entitled to the rate of pay appropriate to an adult skilled worker in that trade.

It might be argued that employment itself acts as a test of competence, for the man who cannot do the work properly will find it hard to get, and keep, a job. This is, unfortunately, not true. With the present shortage of labour most firms must scrape the barrel and hold on to workers even if their ability proves of a very low grade. It is possibly because of this lack of any test of competence, coupled with the insistence on five years training, that employers are unwilling to go to the trouble and expense of providing good teaching. However quickly boys master the techniques and however skilful they become, the full five years have still to be served.

There are some who justify the lack of instruction in the shop on the ground that the day at the technical college provides the opportunity for formal teaching ; but whilst the colleges do, generally, provide practical instruction of a high level this is not their primary function. The day release is intended to give the apprentice the opportunity to get some theoretical understanding of his craft and to learn the scientific principles on which it is based. Most of the work is, and is intended to be, class instruction, not practical training. Unfortunately, whilst the practical training, which is the minor part of the teaching given by the colleges, is excellent, the classes have proved to be far beyond the comprehension of most of the apprentices attending them. They are geared to the examinations of the City and Guilds of London Institute on the assumption that an apprentice should be able to take the Intermediate Examination at the end of three years and the Final Examination at the completion of his five years apprenticeship. The syllabuses and the standards of the examinations are described by the Institute as being such that the Intermediate represents the attainment of a worker who has skill in a strictly defined operation but has not taken an apprenticeship training, whereas the Final represents the level required of a craftsman or mechanic who has served a full apprenticeship. In fact, only a tiny minority of craft apprentices ever manage to reach even the Intermediate standard, much less the Final. The large majority of boys who attend the colleges for these courses find themselves completely at sea and compelled to repeat year after year the same course because they cannot master sufficient of the content to justify them being moved on to the next section.

This should be no matter for surprise to anybody willing to give a little thought to the matter. The syllabuses and classes were designed when attendance was voluntary and the boy who was keen to get on was prepared to study in his own time. If he found the work above his head he ceased to attend, and the classes were thus composed solely of the keenest and most intelligent boys. Nowadays, with compulsory day release as part of the agreed schemes, boys attend because they are sent by the employer and paid for their time. There is no selection. Good and bad, dull and intelligent, those who are keen to learn and those who resent being " sent back to school "—all share the same classes and are expected to sit the same examinations. It is little wonder that the failure rate is so high.

What is more surprising is that employers care so little whether the boys reach the grade or not. Many do not even bother to inquire about the results and there are some who withdraw a boy on his eighteenth birthday even if he is in the middle of a course in which he is doing well. Perhaps the lack of interest shown by both the firms and the unions may contribute to this high proportion of failures, for if apprentices know that they will get the adult rate on their twenty-first birthday whatever the standard they have achieved, there is little incentive to the less bright to struggle.

Great Britain is not the only country with industries which are dependent on skilled labour, but she is the only big country in which so little attention is given to training them. In no other country is the period of apprenticeship so long ; in no other country is there the same inflexibility with regard to age ; and in the major industrial countries, workers are not entitled to claim the adult skilled rate until they have given proof, by passing an appropriate test, that they actually possess the skill demanded. In France and Germany and the Netherlands a large part of the training is done in special schools where pupils are given comprehensive practical and theoretical instruction.

There is no doubt that the time has come for a thorough overhaul of our system of training. Experience has shown that the schemes now in operation are inadequate, whether we consider them from the point of view of their success in providing the number of skilled men needed, or whether we think of them from the point of view of the training they provide. Our competitors have the advantage of being able to mobilise all potential ability whatever the age of the worker possessing it ; and they have designed schemes which ensure that the man who claims to be a skilled craftsman really has the skill on which he bases his claim. We do neither and are likely to suffer in consequence.

What can be done ? First and foremost,

let us recognise the absurdity and illogicality of the age restriction. It is ironic that the very organisations which have done so much to instigate and support the trend towards a greater equality of educational opportunity for the mass of the population should be the ones to shut the door in the face of their fellow workers who wish to enter their ranks. Many semi-skilled men who regret their lost opportunities could do the more skilled jobs if they were given the chance to get the necessary training ; it is only the exercise of a harsh monopoly power which prevents them from doing so. If recognition as a skilled craftsman depended on passing a test of competence instead of, as now, solely on the length of training at a particular age, a semi-skilled operative might, by working at a technical institute in the evenings, get the opportunity to better himself. This would be both more just to him and better for industry which needs him.

Second we must accept the fact that there are different degrees of intellectual ability as well as manual skill. To assume that every boy who gets accepted for an apprenticeship (a process which is rarely more than casually selective) is necessarily capable of mastering the technical instruction which was planned for the most intelligent and enthusiastic pupils is as illogical as to assume that every boy who gets into a grammar school is capable of taking an honours degree at a university. We must recognise a heirarchy of talent and provide for it accordingly. This does not mean that the less intelligently endowed apprentice does not need to go to school or college during his training. On the contrary, he does. But to set him to a task which is quite beyond his power is to make him bored and resentful and distrustful of any educational effort. The County Colleges planned by the Education Act were intended to offer a wider and more flexible curriculum than the merely technical. They were designed to give young people some understanding of the society in which they live and of their own part and that of their industry, in it. If the apprentices who now attend the classes in which they are completely lost could instead be provided with something more closely tailored to their needs the day at college could be made both enjoyable and valuable.

It is possible that even for the abler boys who can profit from the courses a different arrangement of time might be more suitable. For apprentices of a higher grade—those training for technical jobs—a "sandwich" system has been introduced in which a period of months in the shops is followed by a period of full time study at college. It might be that a similar system for the craftsman would be more effective. Five months at work followed by one month at college would provide just the same number of study hours as the present system of day release ; but it would give the colleges a chance to plan a course of instruction designed to meet the needs of the apprentice and time to carry it into effect.

Such changes, valuable as they may be in themselves, would not, however, solve the problem of the shortage of numbers. As long as adolescents' wages are as high as at present it is unlikely that many more small or moderate sized firms will be willing to increase the number of their apprentices. Two possible ways out of this difficulty may be suggested. Groups of firms might join together to share the cost of a number of apprentices who move from one firm to another for their training. This is already being done on a small scale in London and in the Midlands. The main disadvantage is that it takes a lot of organising and it may cost as much time and money to persuade a large number of such schemes to be set up as the expense of apprenticeship to individual firms.

A more constructive proposal because it can be done on a large scale is to substitute apprenticeship to a whole industry for apprenticeship to an individual employer. This is done in America in the building industry and overcomes the unwillingness of a firm to face the risk involved in becoming responsible for apprentices for a long period of time in a kind of production that is bound to be to some extent irregular. To be successful, such a scheme would need to be run by a Joint Apprenticeship Council composed of representatives of both unions' and employers' associations, which would make itself responsible for paying the wages of the apprentices indentured to it and for supervising their training. As the funds would be provided by employers in proportion to their wages bill the cost of training the skilled workers on whom all depend would be spread more fairly over the whole industry instead of, as now, being concentrated on those firms that have been willing to undertake their responsibilities voluntarily.

Such a scheme would have an additional advantage. It is often difficult for the small firm, with the best will in the world, to give its apprentices an all-round training because its own work may be highly specialised. Apprenticeship to an industry would get over this difficulty because the trainee could be moved from firm to firm.

It is much to be hoped that the Carr Committee Report will discuss some of these possibilities. But the first essential is for industry and unions to face the realities of the present situation and be prepared to consider a radical reorganisation.

# Theory of Regenerative Machine Tool Chatter*

By S. A. TOBIAS, D.Sc., Ph.D.,† and PROFESSOR W. FISHWICK, Ph.D.‡

No. I

ALTHOUGH an appreciable amount of research has been done already on machine tool chatter, little use is made of the results by production engineers and machine tool designers. This appears to be due to three reasons : (i) some of the recommendations based on theoretical considerations appear to be contrary to practical experience ; (ii) owing to the large number of parameters involved in chatter phenomena the theoretical recommendations for the avoidance of chatter are necessarily of great complexity and they have not been presented in a form suitable for direct application in the design office ; (iii) although it is known that chatter occurring in the various types of machine tools is essentially due to the same basic physical phenomena, at the present time there does not exist a general theory which would cover all the special cases. As a result chatter arising in each of the various types of machine tools must be treated as an individual problem, thus increasing the difficulty of applying the theoretical recommendations.

It has been pointed out that by increasing the stiffness between work piece and cutting tool the danger of chatter is decreased. At the same time, as every production engineer knows, chatter is often eliminated by easing some of the locks of machine tool slides, &c., and thus increasing the structural flexibility. Designers are aware that some flexible machines appear to perform better from the point of view of chatter than similar machines with appreciably greater stiffness. The answer given by the research worker is that in chatter phenomena damping also plays a highly important part and that in some cases a loss of stiffness may be accompanied by an increase of damping, resulting in an elimination of chatter. Unfortunately, this explanation is not satisfactory even from the theoretical point of view since the quantitative relationship between these two factors is at present unknown.

It is well known that, in addition to stiffness and damping, the cutting speed, the feed, the geometrical form of the tool, the work piece material, the foundation of the structure, &c., all play an important part in chatter. However, the individual effect of these parameters is insufficiently explored and so in a particular case it is difficult to say which parameter should be altered and in what way, in order to eliminate any chatter. Thus, as a rule, chatter is eliminated by time and money-consuming random experimentation. It is clear that owing to the large number of parameters which have an influence on the chatter behaviour of a machine, a theory which would consider all essential factors would be of such enormous complexity that there is little hope for its practical application in the drawing-office or in the workshop. This difficulty can be overcome only by the introduction of "group parameters" upon which a relatively simple mathematical theory can be built. It would be an additional advantage if the final results of such a theory could be presented in a graphical form, thus eliminating the necessity of time-consuming laborious calculations. Furthermore, it is desirable that the mathematical part of this theory should be directly valid for all kinds of chatter occurring on the various kinds of machine tools and that individual cases should be derived from it by a substitution of the operative values of the group parameters corresponding to the particular type of machining under consideration. Such a unified picture of the chatter phenomena would not only facilitate the application of the theoretical results, but would also permit the rapid solution of unusual cases previously not investigated.

A theory for drilling chatter which to some extent satisfies these demands has recently been published by the authors (subsequently referred to as [1]).§ In the present article this theory will be extended to include other kinds of machining processes.

* This article is an extended version of a paper read at the "Second Colloquium for Machine Tool Research and Design" (2.FoKoMa), held at the Technische Hochschule, München, 1955.

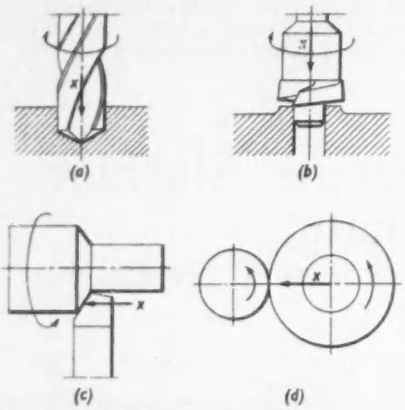
† Assistant Director of Research, Department of Engineering, Cambridge University.

‡ Professor of Electrical Engineering, University College, Swansea.

§ References are given at the end of this article.

### Scope of the Theory

The present theory is mainly concerned with regenerative chatter, but other types will also be included. Regenerative chatter occurs when part of the chip removed by a cutting edge has previously been cut, either by the same cutting edge (single edge tools, such as lathe tools or grinding wheels), or by another cutting edge which is solidly connected to the first (multi-edge tools, such as drills, face millers, &c.). In this case the forces acting on the cutting edge at a certain time instant are partly determined by the form of the chip removed at an earlier time. We shall restrict the scope of the exposition by confining ourselves to those kinds of machining in which under chatter-free conditions the chip thickness removed is constant.




(*a*) drilling ; (*b*) face milling ; (*c*) turning ; (*d*) grinding. It is assumed that the chatter amplitudes fall in the direction *x*.

**Fig. 1—Cutting processes embraced by the theory**

Thus, we shall be concerned with drilling, certain types of face milling, turning (shaping) and grinding, as shown on Fig. 1.

In the cases shown on Fig. 1 the cutting edge has three rectilinear degrees of freedom which fall in the direction of the feed motion, the direction of the cutting velocity, and the direction which is perpendicular to the other two. Chatter confined to the plane perpendicular to the cutting velocity will be called type-A chatter, irrespective whether its direction is given by the feed motion (denoted by $x$ in Fig. 1(*a*) to 1(*c*)) or the direction perpendicular to it. Type-B chatter is entirely confined to the direction of the cutting velocity. In the present paper we shall consider only type-A chatter and the more general theory which treats both types will be left for a future publication.

### A Theory of Regenerative Chatter

Consider a machining operation in process with a nominal feed $s_0$ inch/rev. and $v_0$ =constant cutting velocity. Under these conditions the particular machine tool can be regarded as a dynamical system which is in steady motion. It will now be investigated whether this motion is stable or unstable—that is, in the terminology of the production engineer, whether the machining will be free of chatter or not. This will be done by assuming that there is a relative vibration $x$ between work piece and cutting edge which falls in the directions shown on Fig. 1(*a*) to 1(*d*). This vibration will be expressed as

$$x=Ae^{\alpha t}\cos\omega t \quad . \quad . \quad . \quad . \quad (1)$$

where $A$ is an arbitrary amplitude factor and $\alpha$ and $\omega$ are at present unknown, but will be determined in the course of the calculation. We shall investigate for which values of the system parameters $\alpha \lesseqgtr 0$. Clearly, when $\alpha<0$ equation (1) represents a damped oscillation and as $t$ increases $x\to 0$ and so the nominal feed establishes itself. In this case we shall say that machining takes place under stable conditions. When $\alpha>0$ the superimposed vibration increases in amplitude as time goes on and tends to infinity. In practice, some limiting factor will stabilise the amplitude at a finite but unpleasantly large value. The case $\alpha>0$ signifies unstable machining conditions. Finally, when $\alpha=0$ the system is on the threshold of stability and in that case, once initiated, the vibration amplitude remains at its initial level.

It must be emphasised that throughout the following analysis no attention is paid to the question as to how energy can be fed into the system or how the amplitudes build up and stabilise themselves at their final level. In accordance with the procedure usually adopted for the investigation of the stability of dynamic systems, the view is taken that if the values of the system parameters are such that the system is unstable, the smallest disturbance (a hard spot in the material, unbalance vibrations, &c.) is sufficient to induce it to leave its steady state of motion and to burst into oscillations (to chatter). Thus the analysis is only concerned with the problem of stability—that is, whether or not the machine will chatter under certain working conditions.

The general procedure of the method employed can now be summarised as follows : the presence of the assumed vibration $x$ entails an alteration of the cutting conditions as a result of which superimposed on the steady state cutting thrust component $P_x$ a thrust increment $dP_x$ is generated. Since $dP_x$ is caused by $x$, it will be a function of $x$ and so of the time $t$ ; $dP_x$ is acting on the elastic components of the system (work piece and cutting tool) and it may be such as to either increase $x$ or decrease it or leave it on its original level. In the first case the calculation will yield $\alpha>0$ and then the system is unstable, i.e. chatter will occur. In the second case $\alpha<0$ which indicates stability and finally in the third case $\alpha=0$, which shows that the system is on the threshold of stability.

It will be assumed that the cutting force thrust component $P_x$ which falls in the direction $x$, according to Fig. 1, is a function of the instantaneous values of the following four parameters : the total chip width $b$ inch, the total chip thickness $s$ inch/rev., the rate of penetration (feed velocity) $r$ inch/sec, and the cutting speed $v$ inch/sec; $v$ is dependent on the rotational speed of the tool or work-piece $\Omega$ rev./sec as $v=2\pi R\Omega$, where $R$ is the radius from the centre of rotation. Assuming that the chip width $b$ remains unaffected by the presence of the vibration $x$, it can be neglected from further considerations. Under steady state machining conditions the remaining three parameters are related by $r=s_0\Omega$ and then the total chip thickness $s$ is equal to the nominal feed $s_0$. In this case it is sufficient to say that the thrust $P_x$ is a function of $s_0$ and $\Omega$. However, under dynamic conditions the chip thickness $s$ may vary independently of the feed rate $r$ and both may be only partly determined by the nominal feed $s_0$, as we shall see presently in greater detail. Thus, in general, the thrust can be written $P_x=P(s, r, \Omega)$ and so the incremental thrust can be expressed as

$$dP_x=k_1ds+k_2dr+k_3d\Omega \quad . \quad . \quad (2)$$

where $k_1=(dP_x/ds)_0$ represents the increase of the thrust per unit increase of chip thickness, all other variables remaining constant. $k_2=(dP_x/dr)_0$ and $k_3=(dP_x/d\Omega)_0$ have an analogous meaning with respect to the feed rate and the cutting speed, respectively. All three constants are evaluated under steady state conditions.

Consider changes from one steady state to another under the following experimental conditions : (i) steady state machining tests are being carried out at constant speed ($d\Omega=0$) and only the nominal feed $s_0$ (which in this case is equal to the total chip thickness) is varied. By plotting the thrust $P_x$ as a function of the feed a graph of the kind shown on Fig. 2(*a*) is obtained. From

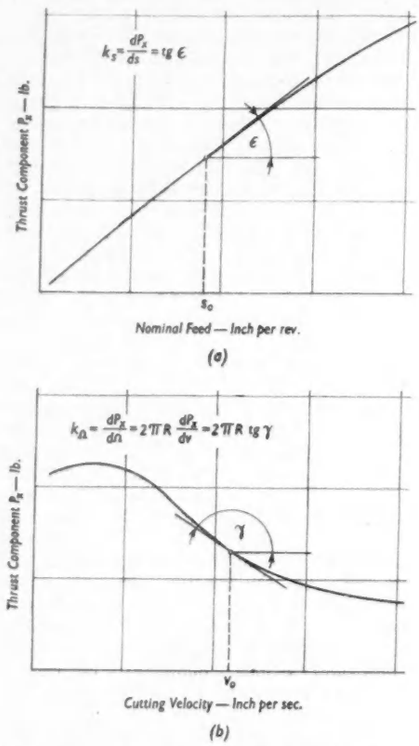



**Fig. 2—Determination of the factors $k_s$ and $k_\Omega$ from cutting thrust measurements**

this graph the incremental thrust force, for a variation of the feed $s_0$ by $ds_0$, is given by $dP_x=k_sds_0$, where $k_s$ is the slope of the $P_x$ thrust curve at $s_0$. Mathematically these experimental conditions are represented by equation (2) when we put $ds=ds_0$, $dr=ds_0\Omega$, and $d\Omega=0$, and so

$$dP_x=k_1ds_0+k_2\Omega ds_0=k_sds_0 \quad . \quad . \quad (3)$$

from which

$$k_s=k_1+k_2\Omega \quad . \quad . \quad . \quad . \quad . \quad (4)$$

(ii) Consider now the case when the feed is kept constant and the tool or work piece speed is varied. By plotting the $P_x$ thrust as a function of $v_0$ we obtain in some cases a curve of the kind shown on Fig. 2(*b*). Mathematically, when $ds=0$ but $d\Omega\neq 0$ and so $dr=s_0d\Omega$ equation (2) yields

$$k_\Omega d\Omega=0+k_2dr+k_3d\Omega \quad . \quad . \quad . \quad (5)$$

and so

$$k_3=k_\Omega-k_2s_0=k_\Omega-(k_s-k_1)(s_0/\Omega) \quad . \quad (6)$$

Thus equation (2) can be written :

$$dP_x=k_1ds+(k_s-k_1)\frac{dr}{\Omega}+\left[k_\Omega-(k_s-k_1)\frac{s_0}{\Omega}\right]d\Omega$$

$$. \quad . \quad . \quad . \quad . \quad (7)$$

We shall write $(k_s-k_1)=K$. In equation (7) there are three constants, $k_1$, $k_s$ and $k_\Omega$, which have to be determined experimentally. The experimental evaluation of $k_s$ and $k_\Omega$ is obvious from the derivation of the equa-

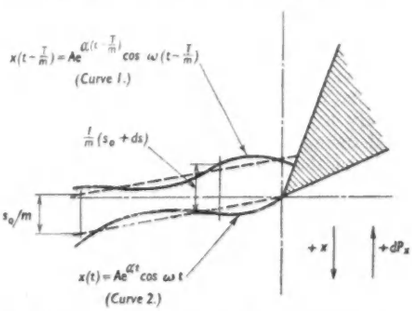
tion. However, the evaluation of $k_1$ is not so simple, partly because it is essentially a dynamic factor which does not appear in the work of previous investigators. This is not surprising when it is considered that their work is concerned with steady state machining conditions. In this case the nominal feed $s_0$ and the feed rate are related by $r=s_0\Omega$, as has already been pointed out. However, $k_1$ can be determined only from experiments in which the chip thickness $s$ and the feed rate $r$ are independently varied. The design of such experiments is by no means an easy matter and needs further discussion. An approximate evaluation for $k_1$ for the case of drilling has been given by the authors elsewhere.[1]

Assuming the values of $k_1$, $k_s$ and $k_\Omega$ are known, $dP_x$ is found by calculating the chip thickness variation $ds$, the feed rate variation $dr$ and the rotational speed variation $d\Omega$.

### Type-A Chatter

In this case the rotational speed $\Omega$ is not directly affected by the presence of $x$. Speed variations may occur owing to the variation of the load which may set up vibration in the spindle drive, but this possibility will be disregarded and so we put $d\Omega=0$.

The chip thickness variations occurring in the types of machining shown on Fig. 1(*a*) to 1(*c*) will be explained on Fig. 3. This




The instantaneous chip thickness is given by $(1/m)(s_0+ds)$.

**Fig. 3—Variation of the chip thickness**

figure shows a section through one of the cutting edges at time $t$ in a plane including cutting speed vector and the direction $x$. If the nominal feed be $s_0$ then under steady state conditions each cutting edge removes a chip of uniform thickness $s_0/m$, where $m$ is the number of cutting edges of the tool. The form of this chip is indicated by the dotted lines in the figure. Owing to the presence of the vibration $x$ the upper surface of the chip has been cut in the form of a wave (curve 1) when it was machined last by the cutting edge which directly preceded the edge shown in the figure. If the time of one revolution of the tool (drilling and face milling) or of the work piece (turning and grinding) is $T=1/\Omega$ then the upper surface of the chip was last cut at time $t-T/m$. As at time $t$ the cutting edge proceeds along curve 2. The instantaneous chip thickness removed is given by $(s_0+ds)/m$, where

$$(1/m)ds=x(t)-\mu x(t-T/m) \quad . \quad . \quad (8)$$

where $\mu$ is the factor of overlapping between the previous cut and the present cut. Clearly, in the case of drilling $m=2$ (there being two cutting edges) and $\mu=1\cdot0$ since the whole width of the top surface of the chip has been modulated by the previous cut. For face milling we usually have $m=3$, 4, &c., but still $\mu=1\cdot0$. In the case of turning $m=1$ and $\mu\leqslant1\cdot0$. For grinding we have also $m=1$ but the value of $\mu$ depends on whether the direction of the feed motion is perpendicular to the work piece surface ($\mu=1\cdot0$) or is parallel to it ($\mu<1\cdot0$). It should be added that $\mu=0$ for all types of machining under consideration during the first $1/m$-th revolution of the tool or the work piece. Thus, the theory is also concerned with chatter which occurs in the initial stage of cutting when interference between the previous and the present cut has not yet taken place.

The determination of the variation of the feed rate $dr$ is quite simple. When superimposed on the nominal feed $s_0$ the vibration $x$ is present the nominal rate of penetration $r=s_0\Omega$ becomes $(r+dr)$, where $dr=dx/dt$ and $x$ is given by equation (1).

Substituting $ds$ from equation (8) and $dr=dx/dt$ into equation (7) we obtain for the most general case

$$dP_x=k_1F_1(\alpha,\omega,\Omega,\mu)x+\left[k_1F_2(\alpha,\omega,\Omega,\mu)+\frac{K}{\Omega}\right]\frac{dx}{dt} \quad . \quad . \quad . \quad . \quad . \quad (9)$$

where

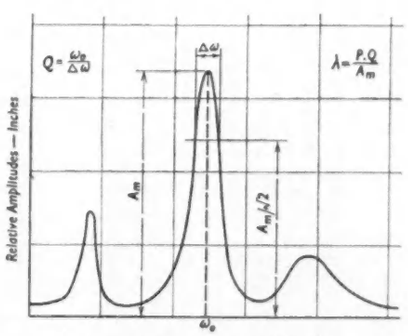
$$F_1=\left[1-\mu e^{-\alpha\frac{T}{m}}\left(\cos\omega\frac{T}{m}+\frac{\alpha}{\omega}\sin\omega\frac{T}{m}\right)\right]m\ ;$$

$$F_2=\left(\frac{1}{\omega}e^{-\alpha\frac{T}{m}}\sin\omega\frac{T}{m}\right)\mu m \quad . \quad . \quad . \quad . \quad (10)$$

### Derivation of the Equation of Motion

Let us now direct our attention to the point where the cutting edge makes contact with the work piece and assume that a harmonic force of variable frequency (a vibration generator) is acting at these two points in the direction $x$, as shown on Fig. 1(*a*) to 1(*d*). By measuring the relative amplitudes between cutting edge and work piece and plotting them as a function of the exciting frequency a resonance curve of the type shown on Fig. 4 is obtained. The frequencies at which the amplitudes become a maximum correspond approximately to the natural frequencies of the system. It will be seen that under suitable conditions any one of these can be excited by regenerative chatter.

When the tool is highly flexible in the direction $x$ and the structure is very stiff, then




The dynamic amplification factor $Q$ and the dynamic stiffness $\lambda$ are determined from the resonance curve ($P$ = exciting force in pounds).

**Fig. 4—Resonance curve of relative amplitudes between cutting edge and work piece in the direction $x$ of Fig. 1**

the resonance frequencies of Fig. 4 are easily calculated by giving due considerations to the end conditions. For instance, a lathe tool with a large overhang, a boring bar or an internal grinding wheel support, may be regarded as a cantilever clamped at one end. We shall assume that this cantilever is very stiff in the directions perpendicular to $x$. In this case, the natural frequencies of the cantilever are well separated and when vibrating in any one of them it can be represented by an equivalent single-degree-of-freedom system. Considering now one particular natural frequency $\omega_0$ and its corresponding mode of vibration, the differential equation of the equivalent system can be written as

$$M\frac{d^2x}{dt^2}+c\frac{dx}{dt}+\lambda x=-dP_x \quad . \quad . \quad (11)$$

where $M$, $c$ and $\lambda$ are suitably chosen quantities for the particular mode of vibration. It is convenient to introduce non-dimensional quantities by putting

$$\lambda/M=\omega_0^2 \quad \text{and} \quad c/\lambda=1/Q_e\omega_0 \quad . \quad . \quad (12)$$

where $\omega_0$ is the natural frequency of the particular mode and $Q_e$ is the effective amplification factor of the system. The structural amplification factor $Q$ is determined from the resonance curve (Fig. 4) by dividing the natural frequency of the particular mode by the resonance curve width at $1/\sqrt{2}$ of the maximum amplitude. $2Q$ is the ratio of critical damping to actual damping. $Q_e$ corresponds to the structural $Q$ reduced slightly to account for the additional damping at the cutting edge ($Q_e<Q$). $\lambda$ is the dynamic stiffness of the mode under consideration, which is also found from the resonance curve as

$$\lambda=\frac{\text{Exciting force}\times Q}{\text{Resonance amplitude}} \quad . \quad . \quad (13)$$

In general, the dynamic stiffness of the various modes differ from each other and from the static stiffness encountered by a static force which acts between work piece and cutting edge in the direction $x$.

By the introduction of the non-dimensional quantities of equation (12) and the consideration of the expression $dP_x$ (equation (9)), the differential equation of the system can be written as

$$\frac{1}{\omega_0^2}\frac{d^2x}{dt^2}+\left(\frac{1}{Q_e\omega_0}+\frac{k_1}{\lambda}F_2+\frac{K}{\lambda}\frac{1}{\Omega}\right)\frac{dx}{dt}+\left(1+\frac{k_1}{\lambda}F_1\right)x=0 \quad . \quad . \quad . \quad (14)$$

where $F_1$ and $F_2$ are given by equations (10).

It should be added that when the tool is very stiff in the direction $x$ (for instance, in the case of drilling) its dynamic characteristics are determined mainly by its end conditions —that is, the dynamic characteristics of the structure. In this case, it is permissible to represent the system by an equivalent single-degree-of-freedom system as long as the natural frequencies of the structure are well separated and/or the damping of the corresponding modes is small. When neither of these conditions is satisfied the complexity of the problem is greatly increased, since the various modes become coupled and so the present method ceases to be directly applicable.

### The Threshold of Stability Conditions

Substituting equation (1) into equation (14) we obtain two transcendental equations from which $\alpha$ and $\omega$ can be determined.

$$\left(\frac{\alpha}{\omega_0}\right)^2-\left(\frac{\omega}{\omega_0}\right)^2+\alpha\left[\frac{1}{Q_e\omega_0}+\frac{k_1}{\lambda}F_2+\frac{K}{\lambda}\frac{1}{\Omega}\right]+\left(1+\frac{k_1}{\lambda}F_1\right)=0 \quad . \quad . \quad . \quad . \quad (15)$$

$$\frac{2\alpha}{\omega_0^2}+\frac{1}{Q_e\omega_0}+\frac{k_1}{\lambda}F_2+\frac{K}{\lambda}\frac{1}{\Omega}=0.$$

We are primarily concerned with the question whether a disturbance will build up ($\alpha>0$) or decay ($\alpha<0$), and so it is sufficient to consider the threshold of stability conditions ($\alpha=0$), which are derived as follows

$$-\left(\frac{\omega}{\omega_0}\right)^2+1+\frac{k_1}{\lambda}m\left(1-\mu\ \sin\ \frac{2\pi}{m}\frac{\omega}{\Omega}\right)=0\ .\ (16)$$

$$\frac{1}{Q_e}+\frac{k_1}{\lambda}m\mu\frac{\omega_0}{\omega}\sin\frac{2\pi}{m}\frac{\omega}{\Omega}+\frac{K}{\lambda}\frac{\omega_0}{\Omega}=0\ .\ (17)$$

where the dimension of $\omega_0$ and $\omega$ is c/sec.

### The Stability Chart

Owing to the transcendental nature of equations (16) and (17) their direct practical application is most cumbersome and so they are conveniently presented in the form of a stability chart. This chart shows those rotational speeds ($\Omega/\omega_0$) at which the system is stable, unstable or at the threshold of stability, for a given structure (characterised by $\lambda$, $\omega_0$ and $Q$), and a given tool, work piece material and machining condition ($m$, $k_1$, $K$, $Q_e=Q-\Delta Q$, and $\mu$, &c.). The abscissa of this chart (Fig. 5 to Fig. 8) represents the non-dimensional rotational speed ($\Omega/\omega_0$) multiplied with the number of cutting edges $m$, where $\omega_0$ is the natural frequency of the mode of vibration, the stability of which is being investigated. The ordinate corresponds to the effective $Q=Q_e$. The chart contains stable and unstable regions which are divided by boundary lines corresponding to the threshold of stability ($\alpha=0$). The method with which the boundary lines can be calculated from equations (16) and (17) has been described.[1] Some information concerning the stability chart can be obtained by the following considerations.

*The Region of Unconditional Stability.*—Equation (17) can be written

$$\frac{\omega}{\omega_0}B=-\frac{k_1}{\lambda}m\mu\sin\frac{2\pi}{m}\frac{\omega}{\Omega}\quad .\ .\ (18)$$

where

$$B=\frac{1}{Q_e}+\frac{K}{\lambda}\frac{\omega_0}{\Omega}\quad .\ .\ .\ .\ (19)$$

By squaring equation (18) and dividing it by $(\omega/\omega_0)^2$ from equation (16) we obtain after expansion

$$\cos^2\frac{2\pi}{m}\frac{\omega}{\Omega}-B^2\frac{1}{\mu m}\frac{\lambda}{k_1}\cos\frac{2\pi}{m}\frac{\omega}{\Omega}+B^2\frac{\lambda^2}{k_1^2}\frac{1}{m^2}\left(\frac{1}{\mu^2}+m\frac{k_1}{\lambda}\right)=0$$

. . . . . (20)

Regarding $B(Q_e)$ as a variable, there is some $Q_e=Q_m$ at which the roots of equation (20) become complex. This means that there is a minimum $Q_e$ for which oscillation is still possible, but for $Q_e<Q_m$ the system is always stable. It can be shown that

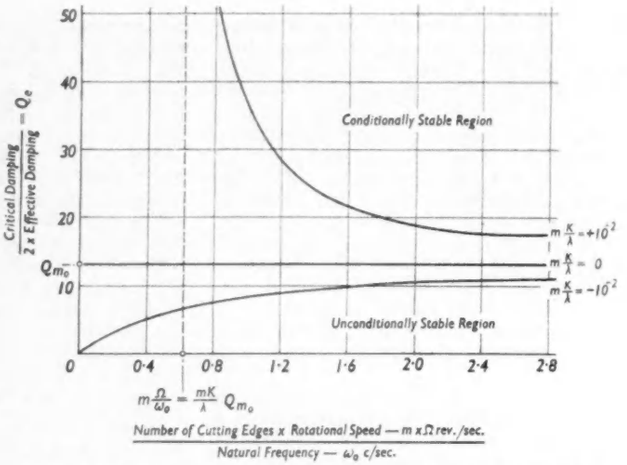
$$Q_m=\frac{1}{\sqrt{2\left[\mu^2\left(\frac{1}{\mu^2}+m\frac{k_1}{\lambda}\right)-\sqrt{1+2m\mu^2\frac{k_1}{\lambda}+\mu^4m^2\frac{k_1^2}{\lambda}\left(1-\frac{1}{\mu^2}\right)}\right]}-\frac{K}{\lambda}\frac{\omega_0}{\Omega}}$$

. . . . . (21)

The $Q_m$ line divides the stability chart into the regions of unconditional stability ($Q_e<Q_m$) and conditional stability ($Q_e>Q_m$). Points lying in the region of unconditional stability correspond to chatter-free machining conditions. The region of conditional stability is divided into speed bands of stable and unstable points. The form of the $Q_m$ line depends primarily on the parameters $K$, $k_1$ and $\lambda$.

*Unconditional and Conditional Stability—Type-A Chatter.*—We can distinguish two extreme cases depending on the overlap factor.

(*1*) $\mu=1\cdot0$.—The boundary line between the unconditionally and conditionally stable region is shown on Fig. 5 for three typical values of $mK/\lambda$. When $K=0$ the $Q_m$ function becomes a constant $Q_{m0}$, indicated in the stability chart by a line parallel to the $m\Omega/\omega_0$ axis. When $K\neq0$ the $Q_m$ line is a hyperbola which for $K>0$ has a vertical asymptote at $m\Omega/\omega_0=m(K/\lambda)Q_{m0}$ and a horizontal asymptote at $Q_{m0}$, approaching it from above, when $K<0$ the $Q_m$ line is also asymptotic to $Q_{m0}$ approaching from below and passing through the origin.




The shape of the $Q_m$ line depends on the value of $mk_1/\lambda(=0\cdot04)$, $\mu(=1\cdot0)$ and the value and sign of $mK/\lambda$.

**Fig. 5—The $Q_m$ line forms the boundary between the unconditionally and conditionally stable regions of the stability chart**

(*a*) When $K=0$ it can be shown[1] that in the conditionally stable region the unstable bands are situated between vertical asymptotes which are found at the speeds

$$m\frac{\Omega}{\omega_0}=2\sqrt{1+(1+\mu)m\frac{k_1}{\lambda}}\ ;\ \sqrt{1+(1-\mu)m\frac{k_1}{\lambda}}\ ;$$
$$\tfrac{2}{3}\sqrt{1+(1+\mu)m\frac{k_1}{\lambda}}\ ;\ \&c.\ .\ .\ .\ .\ (22)$$

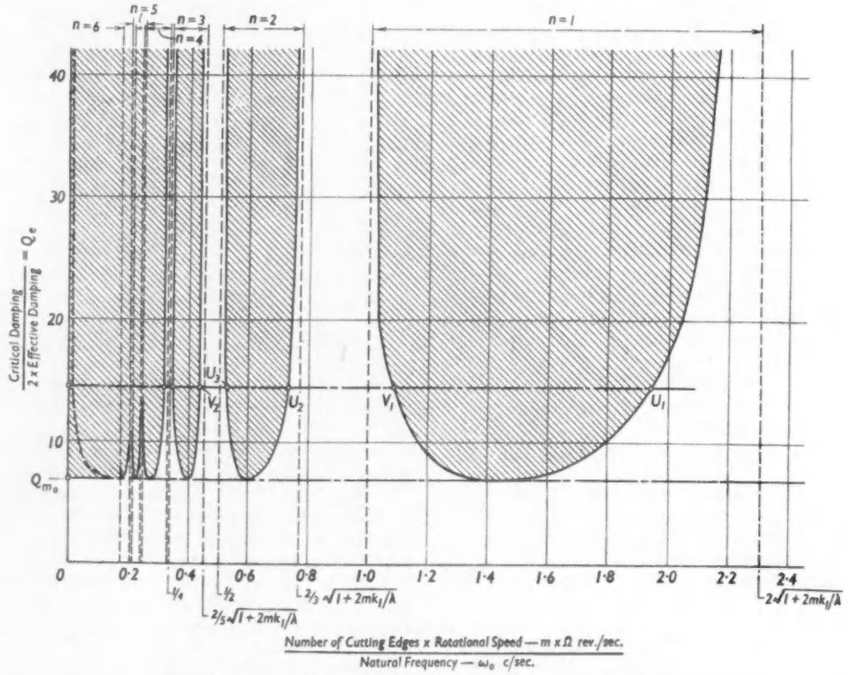
The system is always stable when $m\Omega/\omega_0$ is greater than $2\sqrt{1+(1+\mu)m(k_1/\lambda)}$. Below this limit the unstable speed band of $n$-th order is found between

$$\frac{1}{2n-1}2\sqrt{1+(1+\mu)m\frac{k_1}{\lambda}}>m\frac{\Omega}{\omega_0}>\frac{1}{2n}2\sqrt{1+(1-\mu)m\frac{k_1}{\lambda}}$$

. . . . . (23)

Below a certain speed limit the unstable speed bands overlap.[1] This can happen even with the first and second unstable bands and then at relatively high values of $Q_e$ we shall find a continuous unstable area. At $Q_e$ values only slightly larger than $Q_{m0}$ there will usually be stable speed bands between the lower order unstable bands. However, at the higher order unstable bands these dividing stable bands are so short that below a certain speed limit practically the whole area above the $Q_{m0}$ line becomes unstable. This can be seen from Fig. 6, which shows the stability chart for $\mu=1\cdot0$ and $K=0$. Here overlapping commenced with the fourth band and extends to $m\Omega/\omega_0=0$, that is, zero rotational speed. However, at very low speeds the theory ceases to be valid owing to the elimination of the relief angle of the cutting tool,[1] and so we can expect that the overlapping unstable bands have a lower boundary which has the approximate shape indicated in the figure by the dotted line.

For finite values of $Q_e$, on the threshold of stability, the frequency of oscillation is always greater than the natural frequency of the mode under consideration. From equations (16) and (17) it can be shown that as the rotational speed sweeps through any one of

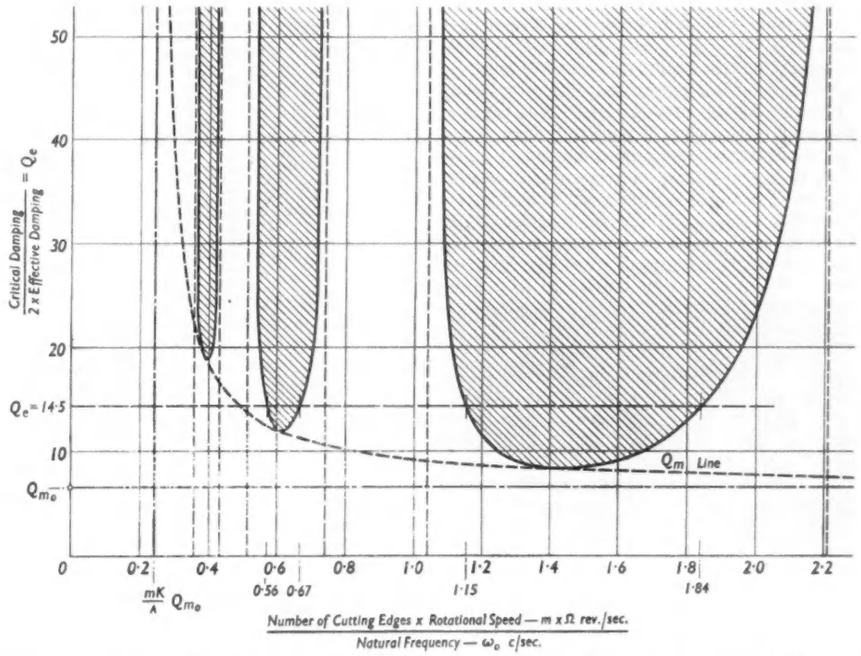



Points lying in the shaded regions correspond to unstable machining conditions.

**Fig. 6—Stability chart for $mk_1/\lambda=0\cdot0785$, $\mu=1\cdot0$ and $mK/\lambda=0$**

the unstable speed ranges in the direction $m\Omega/\omega_0 \to 0$ the frequency decreases from $\omega/\omega_0 = \sqrt{\left[1+(1+\mu)m\frac{k_1}{\lambda}\right]}$ at $Q_e = \infty$, and becomes $\omega/\omega_0 = \sqrt{\left[1+(1-\mu)m\frac{k_1}{\lambda}\right]}$ at $Q_e = \infty$, as $m\Omega/\omega_0$ enters a stable band again. The points lying on the right side of the threshold of stability curves which belong to a particular $Q_e$ (points $U_i$ in Fig. 6) have the same frequency of oscillation. The same is also true for points lying on the left side (points $V_i$).

(*b*) When $K>0$ the higher order unstable bands are raised in the stability chart and are




When $K>0$, the lower order unstable regions are raised in the stability chart ($mk_1/\lambda = 0{\cdot}0785$, $\mu = 1{\cdot}0$ and $mK/\lambda = 0{\cdot}0183$).

**Fig. 7—Stability chart for $K>0$**

less dangerous since they are excited only when the structural $Q$ is very low and/or the stiffness is small. A stability chart of this type is shown on Fig. 7. It corresponds to conditions arising when drilling,[1] (as it has been verified experimentally), and it should also apply to grinding (Fig. 1(*d*)).

(*c*) When $K<0$ the higher order unstable bands are lowered and become consequently more dangerous since they can be excited also when the damping is large. According to the analysis of the drilling process given by the authors[1], stability charts of this type ought to occur in the case of drilling up predrilled holes and also when face milling and possibly when turning.

For $K \neq 0$ points of equal frequency will not lie on a line $Q_e$=constant, but on a hyperbola which is similar to the $Q_m$ line. The important conclusions that $\omega/\omega_0 > 1$, and that by decreasing the drill speed the frequency of oscillation decreases, still hold. Both results have been verified for the case of drilling.

(II) $\mu = 0$, that is, when there is no overlapping between successive cuts we get from equation (21),

$$Q_m = -\frac{\lambda}{K}\frac{\Omega}{\omega_0} \quad . \quad . \quad . \quad . \quad (24)$$

which is meaningful for positive values of $Q_m$. It is convenient to consider directly the damping coefficient of equation (14), which, in this case, takes the form

$$\frac{1}{Q_e\omega_0} + \frac{K}{\lambda}\frac{1}{\Omega} \gtrless 0 \quad . \quad . \quad . \quad . \quad (25)$$

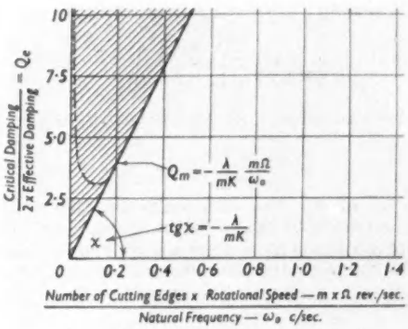
This expression must be negative for oscillations to occur. Since by definition $Q_e > 0$ (otherwise the structure by itself would be dynamically unstable), the expression (25) can be negative only when $K<0$. Thus, when $K>0$ the system is unconditionally stable at all rotational speeds, no matter how small the structural damping may be.

For the case $K<0$ the stability chart is shown in Fig. 8. The $Q_m$ line is a straight line passing through the origin. The region lying below the line is unconditionally stable and the area above is unconditionally unstable. Once more, the results are invalid in the vicinity of $m\Omega/\omega_0 = 0$, owing to the variation of the relief angle, and a boundary line of the approximate shape indicated by the dotted line can be expected.

As will be explained presently, in the case of drilling into solid material and when grinding $K>0$. For drilling up predrilled holes and for face milling it is likely that $K<0$, but $\mu = 0$ only during the first $1/m$-th revolution of the tool. $\mu = 0$ also occurs during the first revolution of the work piece when turning, and always when cutting a screw thread. In the last case chatter represented by Fig. 8 is likely to occur only when one side of the thread is being recut, since otherwise chatter in the direction $x$ shown in Fig. 1(*c*) is probably not possible. However, the stability chart of Fig. 8 shows that chatter may occur even when the cutting speed is constant, and so the influence of a falling or rising cutting force versus cutting speed characteristic (Fig. 2(*b*)) does not enter at all into consideration.

From equation (16) we find that on the threshold of stability the chatter frequency is given by

$$\frac{\omega}{\omega_0} = \sqrt{1+m\frac{k_1}{\lambda}} \quad . \quad . \quad . \quad . \quad (26)$$




Chatter can occur only when $K<0$.

**Fig. 8—Stability chart for $\mu = 0$**

which is constant for all rotational speeds.

As had already been pointed out, the dynamic stiffness (equation (13)) of the various modes of vibration will, in general, differ from each other. Consequently, the stability charts of the various modes for the same cutting conditions take a different form. From the practical point of view it would be an advantage if one and the same stability chart would be applicable to all modes of vibration. This aim can be achieved under certain conditions by the introduction of the average dynamic stiffness $\lambda'$ and the reduced effective $Q$ ($Q_e'$), as will be shown in a subsequent publication.[2]


REFERENCES

[1] Tobias, S. A., and Fishwick, W., 1956, Vol. 170, No. 6, *Proc. I.Mech.E.*, "The Vibrations of Radial Drilling Machines under Test and Working Conditions."

[2] Fishwick, W., and Tobias, S. A., 1955, **Paper read at the 2nd FoKoMa**, "The Effect of Flexible Supports on Machine Tool Chatter." (In the press.)


*(To be continued)*

## British Standards Institution

*All British Standard Specifications can be obtained from the Sales Department of the Institution at 2, Park Street, London, W.1.*

### BUILT-ON COOLANT PUMPS FOR INTERNAL COMBUSTION ENGINES (NOMINAL OUTPUT 1750-17,500 GALLONS PER HOUR AT 30FT MAXIMUM HEAD)

No. 2896 : 1957. Price 4s. 6d. This is one of a series of standards designed to secure a measure of standardisation of dimensions of components of internal combustion engines. Its main purpose is to facilitate the interchangeability of certain centrifugal coolant pumps and their components. It is also intended that wherever possible it should apply in whole or in part to all other forms of "built-on" pumps in the capacity range 1750-17,500 gallons per hour at 30ft maximum head. The standard specifies a range of four suction and discharge bore sizes — 1½in, 2in, 3in and 4in, and certain dimensions for suction and discharge flanges, suction and discharge stubs, the pump shaft in the immediate vicinity of the coolant seal, driving splines, the mounting flange and spigot and housing for coolant seals. It is envisaged that pumps embodying these features will be suitable for use on future industrial, locomotive or marine engines in the power range 150-2000 h.p. The standard, which is illustrated, contains an appendix which sets forth a number of useful recommendations on pump design.

### FILLER RODS AND WIRES FOR INERT-GAS ARC WELDING: PART 1, GAS-SHIELDED TUNGSTEN ARC WELDING

No. 2901 : 1957. Price 6s. This standard contains requirements for the more commonly used ferrous and non-ferrous filler materials, although it has been thought advisable at the present time to omit requirements for filler rods and wires for mild steel—this because of the current difficulties encountered in welding this material by the gas shielded tungsten arc process.

It is pointed out that although the rods and wires specified in this standard are all suitable for some form of gas shielding, certain rods and wires are not suitable for shielding with a particular gas, and purchasers should therefore ascertain from the supplier whether the rods or wires are suitable for a particular gas shielding.

# Engineering Applications of Rigid Foamed Plastics

By A. GILMOUR and C. B. FLINDT

*This article summarises the results of some recent work carried out in the research department of Short Brothers and Harland, Ltd., on rigid foamed plastics. The work was concerned with an investigation of the physical properties of such foams and the development of techniques for producing and using them. While the work is not necessarily original, it is hoped that the results may be of interest.*

RIGID foamed plastics can be considered as a froth of resin which has been set hard by the application of heat. They are formed by mixing a suitable resin with other compounds so that gas is liberated within the mixture, thus causing the resin to expand into a lightweight foam which is subsequently cured by baking. The resulting foam has obvious uses as a lightweight structural filler since the mixture can be poured into a cavity and allowed to foam *in situ*. The first foam of this type was produced by Bayer in 1941, but many modifications have been made since that date. The exact nature of the reactions involved are not yet clearly understood, but a rigid foam can be produced by expanding and cross-linking an alkyd resin by means of a di-isocyanate, both the reactions taking place simultaneously. Expansion is caused by the liberation of carbon dioxide as a by-product of the reaction. The amount of expansion which takes place can be controlled by varying the proportions of the constituents and, by this means, foams can be produced having densities varying from 3 lb to 80 lb per cubic foot.

The investigations described in this article are concerned with polyurethane foams and can be divided into three phases, the first to discover a technique for obtaining consistent densities from a given mixture, secondly to investigate the properties of the foams and, finally, to develop techniques for using them.

## Preparation of a Foam

For the production of polyurethane foams, two basic materials are required :—

(i) a polyester resin containing free hydroxyl groups.

(ii) a di- or poly-isocyanate.

In all the experiments detailed in this article, the resin used was Sebalkyd Type A in combination with the di-isocyanate Desmodur T.* Uniformity of foam texture is assisted by adding a small quantity of cellulose acetate butyrate and, to facilitate mixing, polyethylene glycol-mono-oleate (molecular weight 600) should be used as an emulsifier. To accelerate the foaming reaction either 70 per cent sodium lactate solution or N-coco-morpholine may be used. Of these, the former is more active and is suitable when the resin is to be used for filling larger cavities. The quantity of water present in the constituents proved to be of prime importance in controlling the quality of the finished foam. Increasing the proportion of water in a mix will result in the production of a lower density foam with more open structure and a tendency to form blow holes. A typical formulation, which will produce a foam having a density of about 5 lb per cubic foot is as follows : 100 grammes Sebalkyd Type A (unmodified), 0·5 gramme cellulose acetate butyrate powder, 2·5ml polyethylene glycol 600 monoleate, 57·5ml Desmodur T, 0·75ml sodium lactate solution 70 per cent, 0·75ml water.

The Sebalkyd A is heated to a temperature of 200 deg. Cent. followed by the addition of the cellulose acetate butyrate powder which is stirred into solution. The mixture is kept at 200 deg. Cent. until it becomes clear, when the polyethylene glycol mono-oleate is added and stirred in. To remove any volatile matter, mainly water, the container of hot mixture is placed inside a vessel which is then evacuated. After frothing has ceased the vacuum is released and the mixture removed from the vessel to cool. When cool it is transferred to a fume cupboard, or extraction hood, for the addition of Desmodur T.

To achieve adequate blending of the mixture and Desmodur T it is necessary to stir constantly for about ten minutes. When blending is complete the accelerators, sodium lactate and water, are added quickly and rapidly stirred into the mixture. After about one minute the mixture appears frothy and should be immediately poured into the mould, where foaming will commence at once and the mould will be filled within a few minutes. At this stage the foamed resin is soft and tacky and should be allowed to stand for a minimum of six hours, preferably longer, to set before curing.

The cure necessary to develop maximum strength is carried out in an oven at 100 deg. Cent. for one and a half to two hours, and during this period the components must remain within the mould because the foam initially softens and exerts a pressure of about 5 lb per square inch. It has become standard practice in our experiments to allow twenty-four hours to elapse between mixing and curing. If heat is applied too soon after setting, the foam is found to develop elongated cells and blow holes.

When a mixture to the above formula is poured into an open insulating vessel of low thermal capacity, such as a cardboard carton, a density of $4{\cdot}5 \pm 0{\cdot}5$ lb per cubic foot will result.

Cleaning of vessels used for mixing may be carried out by boiling them in caustic soda solution.

## Factors Affecting the Density of the Foam

As mentioned earlier, the quantity of water present in a mix will have a considerable effect on the density of a foam. For instance, in the case of a foam poured into an open mould, if the quantity of water in the mix detailed earlier is reduced to 0·5ml the density will increase to about 10 lb to 12 lb per cubic foot. Conversely, an increase of water to 1·2ml will give a foam density of 2·5 lb to 3 lb per cubic foot. Consequently, for experimental work, it was imperative to remove excess water before mixing, hence the vacuum treatment of the resin.

Fortunately, this is not the only way of controlling the density of a foam when used as a structural filler. The reaction which results in the foam is exothermic and also expansive, so it is possible to slow down or stop the reaction either by cooling or by the application of pressure, or both. These factors can be considered when designing the mould for a specific purpose and used to quench the reaction when desired.

The design of a suitable mould is largely a matter of experience, but the following general principles will assist in arriving at a decision. The heat generated in the foam will depend on the mass of foam within the mould. The cooling of the foam will depend on the thermal conductivity and capacity of the mould and also the ratio of surface area to mass of foam. If the mould cools the foam too quickly it may quench the reaction before the mould is full and will, in any case, produce a higher density foam near the walls. This last effect is sometimes

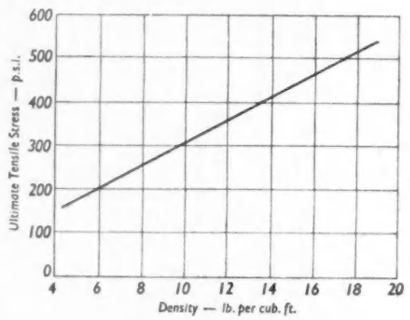



**Fig. 1—Tensile strength**

advantageous in that it produces a reinforced skin on the finished product, but to control the quenching it may be necessary to pre-heat the mould to, say, 50 deg. Cent. The effect of pressure in stopping the reaction can be used by restricting the mould outlets so that, when the foam reaches them, they set up a back pressure which stops any further generation of gas.

If use is made of these methods of controlling foam density, the quantity of water present in the mix becomes much less critical.

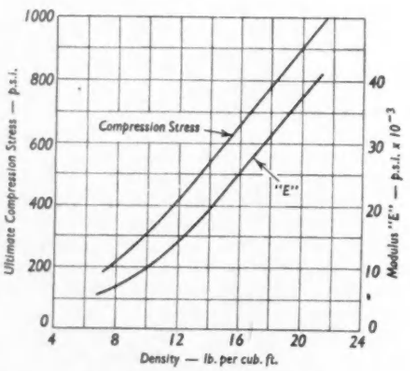



**Fig. 2—Compressive strength**

To obtain a foam of desired density it is only necessary to make up a sufficient weight of mix to fill the mould at the specified density, allowing a little excess for blowing through the mould exits, and use slightly more than the quantity of water theoretically necessary so as to ensure that a sufficient volume of foam will be available. The resulting foam is very uniform in structure and of excellent mechanical properties.

The question of mould design will be discussed later in the section dealing with techniques.

* A list of sources from which materials may be obtained is appended at the end of this article.

## Properties of Foam

*Mechanical Properties.*—The strength of the plastic foam depends, as would be expected, on the density. Tension and compression tests were carried out on 1·5in cubes of foam bonded to steel plates by means of "Araldite D" resin, and the results are given in Figs. 1 and 2. Shear tests on slabs of foam 4in by 2in by ½in yielded the results

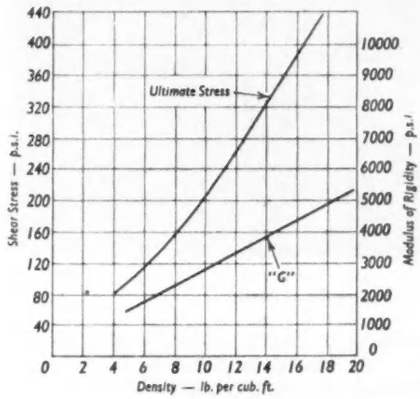



**Fig. 3—Shear strength**

shown in Fig. 3. When foamed in contact with surfaces such as metals primed with "Celletch" etching primer and reducer, or glass fibre laminates, the foam shows adhesion equal to its own cohesive strength. The high density skin effect, mentioned in the preceding section, is a favourable factor in promoting good adhesion. Resistance to fatigue appears to be good, and tests have been carried out on specimens by subjecting them to accelerations of $\pm 20\,g$, at frequencies ranging up to 2500 c/s for ten hours without failure. Machinability of the foam is good and it can readily be drilled, sawn, milled or sanded.

*Thermal Conductivity.*—The thermal conductivity is of importance if foam is used for "potting" electrical devices which liberate heat. Tests were carried out on a pair of 9in discs of foam ½in thick having a flat plate heater sandwiched between them. The

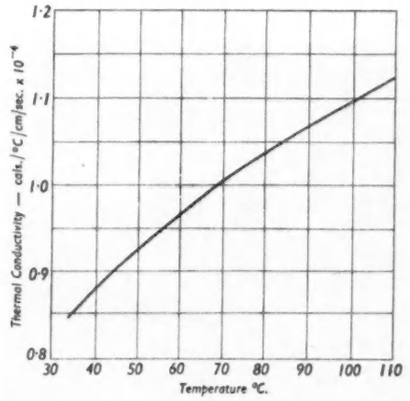


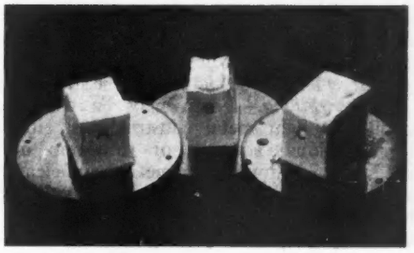

**Fig. 4—Thermal conductivity, 10 lb per cubic foot density**

results shown in Fig. 4 were obtained for a foam of density 10·2 lb per cubic foot. The conductivity is about twice as good as still air and about the same as glass wool.

*Dielectric Properties.*—Because such a large proportion of the foam consists of carbon dioxide, it is to be expected that the dielectric properties would be somewhere between those of the gas and resin. This is realised in practice, and a foam of 6 lb per cubic foot density tested at 30 Mc/s shows a dielectric constant of about 1·30 with a power factor of 0·002. These properties are important since the foam can be used for lightweight covers over radar and microwave aerials and for potting electronic units. Caution must be exercised, however, to prevent moisture absorption in high humidity conditions.

*Miscellaneous Properties.*—In foams of density exceeding 6 lb per cubic foot the cells of the structure are essentially non-communicative and therefore they have some resistance to moisture absorption. A block of foam will float indefinitely in water, but if totally immersed it will gradually absorb some of the liquid. Under conditions of high humidity it is, however, necessary to protect the foam with some other material such as resin impregnated glass cloth or to encase it completely in a metal skin. Exposure to 100 per cent humidity at 40 deg. Cent. produced complete breakdown of the untreated foam in less than twenty-four hours. Fig. 5 shows the result of such exposure on a block of untreated foam and also a block painted with "Araldite D."

The foam is not attacked by oils, greases, hydraulic fluid and most aromatic solvents. Heating in solvents or vapours such as



*A*—Original condition.
*B*—Untreated foam after twenty-four hours.
*C*—"Araldite"-painted foam after twenty-four hours.

**Fig. 5—Effect of exposure on samples of foam**

acetone will eventually result in plasticity and partial collapse of cell structure. It is highly resistant to attack by fungus. Foam is not inflammable in the strictest sense, but it will support combustion.

## Techniques for the Application of Foam

*Moulded Sections.*—The properties of the foam make it particularly suitable for forming moulded structural sections. A technique which has proved extremely satisfactory is the use of foam within a resin-impregnated woven glass skin. The glass cloth, saturated with an epoxy resin, is used to line the mould, the walls of which have previously been treated with Releasil 14 and greased with Releasil 7. When the foam is poured into the mould, the pressure forces the cloth into close contact with the walls, resulting in a very accurate facsimile of the mould form.

The design of a suitable mould is an all-important factor in the production of a satisfactory section. The mould structure must be strong enough to resist distortion by the pressure of the foam, which can exceed 15 lb per square inch, but also light enough to be easily handled. The thermal conductivity of the mould should be high, so that the excess heat from the reaction is removed quickly, but it is equally important to avoid chilling the foam and quenching the reaction. The ideal mould should have high conductivity and a large thermal capacity so that large amounts of heat can be absorbed with little change of temperature.

**Fig. 6—Plaster mould and finished section**

To avoid chilling, pre-heating in an oven or by built-in heaters is essential. The development of a suitable mould is best illustrated by detailing the history of an early specimen.

It was decided that a small aerofoil section should be produced so that structural and aerodynamic tests could be carried out. It was to be made by using the foam and glass cloth technique, described above, and the first mould was made from plaster of Paris backed with aluminium. Initially the mould, shown in Fig. 6, gave fairly satisfactory results, but repeated exposure to 100 deg. Cent. caused the plaster of Paris to dehydrate and crumble to powder.

The next attempt was to produce a sheet metal mould, suitably stiffened, from 18 S.W.G. aluminium. In this case the foam exerted sufficient pressure to distort the mould and render it useless. From this unhappy experience it was estimated that the mould should be designed to withstand pressures up to 30 lb per square inch, to be on the safe side. The final mould was a

**Fig. 7—Lining mould**

Fig. 8—Clamping mould

Fig. 9—Final mixing

casting, suitably machined, and this has produced excellent results.

The technique of preparing and filling the mould is illustrated in Figs. 7 to 11. The mould is first treated with "Releasil" and then lined with the resin saturated glass cloth, Fig. 7. After clamping the mould together, Fig. 8, it is placed in an oven at about 40 deg. Cent. to pre-heat, after which it is removed and placed in a fume cupboard where the final mixing of the foam, Fig. 9, and pouring, Fig. 10, take place at once. As the foam commences to rise, the lid of the mould is clamped in place and foaming continues until the filler begins to appear through the vents. After a little foam has escaped, the back pressure in the mould is sufficient to stop the reaction, Fig. 11. The process is completed by allowing the foam to set for twenty-four hours and then curing for one-and-a-half hours

Fig. 10—Pouring

at 100 deg. Cent., after which the excess foam and glass cloth is removed and the finished section taken from the mould.

A specimen of this type was tested to destruction and failure occurred within the body of the foam, although the load was applied in tension through pads bonded to the skin. No failure of the adhesion between skin and foam occurred.

For small and simple sections such as that described above, the moulding technique is ideal since additional equipment such as radio aerials can be cast into the body of the foam. This saves a considerable amount of time previously devoted to the design and manufacture of suitable brackets and attachments. For larger pieces, the problems of mould design to achieve heat dissipation become more difficult and suitable heat sinks may have to be included in the structure.

*Cavity Filling*.—Foam may be used as a filler in light metal constructions, either for additional strength or to damp out excessive vibration. If the metal is sufficiently strong, the technique of foaming *in situ* can be used but, in any case, the metal surface should be prepared by using the "Celletch" primer referred to earlier. If the cavity is of a suitable shape, with no volumes in which air or gas could be trapped by rising foam, the mix can be poured into, and allowed to fill, the space. It may be necessary to warm the surface of the metal with infra-red lamps or an electric blanket, before pouring, so as to avoid premature quenching of the reaction, and temporary covers may have to be fitted to allow the foam to build up a sufficient pressure.

Curing may present difficulties if the cavity is large and many techniques in this direction have still to be developed.

If the cavity is such as to cause voids due to trapped gas, an injection filling technique such as that described below can be used. A foaming pot is constructed which should be of stout construction and fitted with a lid which can be clamped on. The base of the vessel has a number of outlet pipes controlled by a simple rotary valve. Flexible tubes lead from each outlet and are fed into the awkward spaces in the cavity in such a way that the foam will fill these traps first and then expand into the main space. The mix is poured into the vessel, the outlet tubes being closed by the valve, and allowed to begin foaming. The lid is then placed on the vessel and clamped down while simultaneously the valve is opened. The pressure of the foam then forces it down the pipes and into the cavity. When the cavity is filled the tubes may be withdrawn so that the foam can expand and fill the spaces they occupied. Injection of foam can be stopped by closing the rotary valve and allowing the reaction to stop by pressure build-up.

Care should be exercised in the design of the outlets to prevent them offering too much restriction to the foam and thus quenching the reaction. A suitable material for the tubes is polythene because the foam will not stick to it, making cleaning easier, and it is possible to watch the flow of foam through the tubes during the filling process.

*Potting*.—The term "potting" has become generally used to describe the process of casting electrical or electronic components in resin, which is carried out to enable a compact construction to be devised which has the minimum of component supports and the maximum of strength. Solid resin is, however, rather dense, and the substitution of foam can show a large saving in weight without a serious loss of strength. The main difficulties to be overcome concern the poor behaviour of the foam under conditions of tropical humidity, which makes it essential to protect the foam surface in some way. In some designs the components to be potted are mounted in a metal can which is then filled with foam. This has the added advantage of providing electrical screening, but is not always a convenient method to use. Other lines of investigation include the sealing of the foam surface with a resin or other coating. If heat producing devices, such as valves or resistors, are included in the circuits to be potted, special precautions must be

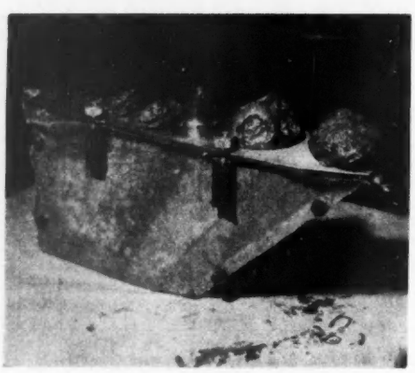


Fig. 11—Filled mould showing excess foam rising through vents

taken to ensure that the heat is conducted away to the surface and dissipated by suitable heat sinks. This is necessary because the resin itself is a very good thermal insulator and liable to damage at temperatures above 80 deg. Cent.

The investigation of these problems is well worth while since weight savings of 50 per cent have been achieved by the use of foam instead of "loaded" resin.

### Safety Precautions

In conclusion, it is necessary to give a word of warning regarding safety of workers employed on these processes.

The isocyanate component of the mixture is toxic and "Neoprene" gauntlets should be worn on all occasions when preparing a foam. A high degree of cleanliness is also required at all times to reduce the liability to dermatitis. It should be borne in mind that the gauntlets will cause the hands to perspire and any slight contamination will quickly spread and enter the open pores of the skin. Over-confidence in operatives should be strongly discouraged.

The isocyanate component and containers contaminated with it, give off fumes which must not be inhaled by the operatives. They will produce a condition similar to a severe attack of asthma and frequent exposure may produce an allergic condition in which the attack may be brought on by normally non-irritant gases. Because of this, all operations concerned with the mixing, foaming and curing of the resin must be carried out under hoods fitted with extraction fans.

The finished and cured foam is quite safe and can be handled continuously without any ill effects.

If an operator should accidentally inhale fumes, relief can be obtained by giving the victim a one quarter grain Ephedrine tablet and allowing him to rest for a period. Isocyanate in the eyes must be treated immediately with drops of olive oil. In all cases a doctor should be informed as soon as possible. It has been found that some operatives are more affected than others and some degree of selection of personnel may become necessary.

### Conclusions

Foam resin shows considerable promise as a structural material, in conjunction with glass fabric or light metal, and it has very good electrical properties. At present it suffers from exposure to humid conditions and is not suitable for use above about 80 deg. Cent., although foams with higher operating temperatures are available in the United States. Mould design is a matter which requires considerable investigation, and some techniques for dealing with large sections have yet to be developed. It is, however, a material which may be expected to figure largely in future developments, and it is hoped that these notes may assist in introducing foamed resin to a wider audience.

### Acknowledgment

The authors would like to express their thanks to the directors of Short Brothers and Harland, Ltd., for permission to publish this article, and to acknowledge gratefully the assistance of their colleague, Mr. G. B. Graham, in carrying out these investigations.

Sources of materials:

| | |
|---|---|
| "Sebalkyd A" ... ... ... | Scott Bader, Ltd., Wollaston, Wellingborough. |
| "Desmodur T" ... ... ... | J. M. Steel, 36-38, Kingsway, London, W.C.2. |
| Cellulose acetate butyrate ... | Kodak Ltd., Kingsway, London, W.C.2. |
| Polyethylene glycol 600 monoleate ... ... ... ... | Rex Campbell and Co., 7, Idol Lane, Eastcheap, E.C.3. |
| "Celletch" ... ... ... ... | Cellon Ltd., Kingston-on-Thames. |
| "Araldite D" ... ... ... | Aero Research Ltd., Duxford. |
| "Releasil 7" and "14" ... | Midland Silicones, 19 Upper Brook Street, W.1. |

Other chemicals are obtainable from British Drug Houses, Poole, Dorset.

# Marconi and Microwave Transmission Beyond the Horizon

By G. A. ISTED*

*A symposium on long-distance propagation above 30 Mc/s was held by the Institution of Electrical Engineers in London on January 28. One group of papers dealt with tropospheric propagation and included a short historical note by G. A. Isted discussing Guglielmo Marconi's work in this field. Isted's paper (abstracted below) described Marconi's experiments between 1928 and 1936 which showed that radio transmission beyond the horizon, by means of microwaves, was practicable. Marconi recognised the influence of tropospheric mechanisms on propagation.*

IN 1896, encouraged by Sir William Preece of the British Post Office, Guglielmo Marconi gave one of the first spectacular demonstrations of communication by means of radio waves. The frequency he used was of the order of 1000 Mc/s. It is interesting that after over thirty years of investigation, during which period he worked successively on low, medium and high frequencies, he finally returned to his original band of frequencies in the years 1928–36.

It is also interesting to consider how different things might have been had Marconi not deviated from his original investigation of microwaves. We might by now, for example, have fully exploited the possibilities of microwave tropospheric scatter mechanisms. We might even now have been turning our attention to longer waves, where rumour would have it that communication could be established over still greater distances with less power than that used on microwaves, and we might now have been theorising on the existence of the ionosphere. That might possibly have been the more logical evolution of the art of radio-communication. It was, however, ordained otherwise, and we are now back, in many respects, to the point at which Marconi began his work.

It cannot be said that Marconi was ever an able recorder of his own technical achievements, and it has been left mainly to others who have had intimate knowledge of his work to place them on record. His work after 1928 was no exception, and it is the pleasant task of the author, who had the privilege of being one of his personal assistants at that time, to link the experiments which Marconi carried out from that year onwards with those being carried out at the present time. In 1928 the presidency of the Italian Royal Academy was conferred upon Marconi. This made it necessary for him to transfer his research activities and staff from England to Italy, although his work continued to be sponsored by British interests.

It is, of course, well known now that the troposphere profoundly affects the propagation of radio waves, particularly those with frequencies within the v.h.f. and u.h.f. bands and beyond. The first direct reference to the influence of the troposphere on radio wave propagation was, however, made by Marconi. This reference was made in respect of experiments, using frequencies just above 30 Mc/s, which were requested by the Italian Government. These experiments, now briefly described, were carried out between Sardinia (Golfo Aranci) and the Italian mainland (Fiumicino).

Arrays of uniform aerials, each of which probably had a gain of about 16 dB, had been erected at both the transmitting and receiving sites, which were virtually at sea level. Transmitters, capable of being modulated by a single speech channel, delivered about 1kW of power to the aerial. Thus, the system achieved an effective radiated power of the order of 40kW. The geometrical optical range given by the combined aerial heights was not more than 34km and the distance was 270km—some eight times the optical range.

The experiments showed quite clearly, by beam-swinging tests, that the angle of arrival of the signal was tangential to the horizon. Meteorological conditions, whilst never causing complete failure of signals, did cause a day-to-day and seasonal modification to the mean signal level. It was noted particularly that the signal level was some 20 dB less in winter than summer.

It was this experimental evidence which prompted Marconi[1] in his address to the Italian Society for the Progress of Sciences in 1930 to say:

> From measurements effected recently it would seem that along the route between Sardinia and the Italian mainland this wave is refracted and contained within a space lying between the surface of the earth and a layer situated somewhat lower than the Heaviside layer.

This is a fair description of the troposphere. From the author's personal knowledge the fading characteristics on this test route were similar to those which we now observe on authentic tropospheric scatter circuits.

We must, of course, bear in mind that during these 30 Mc/s experiments sporadic-E ionisation could have been present. It is also recorded that round-the-world echoes were observed which indicated the probability also of $F_2$-layer propagation; both these factors may possibly have influenced the results. Nevertheless, the continuous presence of the signal at all times makes it certain that tropospheric mechanisms must have been the dominant influence.

It was at the conclusion of these tests that Marconi turned his attention again to the investigation of the behaviour of microwaves. This time he was not alone in this field. Very early in the 1930s Uda[2] in Japan succeeded in communicating between Sendai and Otakamori, a distance of 30km, on frequencies of the order of 600 Mc/s; Pistor[3] in Germany had made valuable contributions to the microwave art; Clavier and Gallant[4] established a two-way communication link across the English Channel between St. Inglevert and Lympne on a frequency of the order of 1500 Mc/s. Marconi himself very soon succeeded in demonstrating communication over distances of the order of 35km on 600 Mc/s so convincingly that the Vatican authorities requested him to provide a similar equipment for communication between the Vatican and the summer residence of His Holiness the Pope at Castel Gandolfo. This installation, the first microwave telephone in the world, was put into regular service[5] in February, 1933. Marconi, however, had no real interest in these short-distance, line-of-sight transmissions. His ambition was to break down the barriers which dared to

* Marconi's Wireless Telegraph Company, Ltd.

impose limitations on the propagation of the radio waves he had made his life's study. With this in his mind he set himself the task of removing the barriers which, at that time, seemed destined for the first time to prevent him from communicating to distances beyond the horizon.

All workers in the microwave field in the early 1930s used the humblest of apparatus. This fact explains the absence of the precise measurements to which we have become accustomed in the past decade or so. There were literally no radio-frequency devices available for the measurement of power, signal intensity, attenuation or, indeed, frequency itself. A brief description of the apparatus used by Marconi may therefore serve to demonstrate the difficulties under which he, and, indeed, other contemporary workers, carried out their pioneering work. It may also serve to enhance their early technical achievements.

The backbone of the electronic apparatus was, without doubt, the so-called electron oscillator. Barkhausen and Kurz discovered in 1919 that, when they applied a negative potential to the anode of a triode valve and a high positive potential to the grid, very-high-frequency oscillations were set up ; whether this was discovered by accident or design is not recorded. It was further found that the frequency generated in this manner, usually higher than 300 Mc/s, was largely dependent upon the applied potentials. Gill and Morrell, in 1922, showed how the Barkhausen-Kurz electron oscillator could be coupled to an oscillatory circuit.

Not every valve would produce the Barkhausen-Kurz continuous-wave oscillations, and when one was found which did, its life often terminated after a few minutes' operation, usually owing to the fact that the grid had melted.

One of the first requirements at this stage was a reliable valve. Marconi developed one during his first year's work which had a life of about forty hours and a power output of the order of 5W at a frequency of 600 Mc/s. A transmitting unit was developed consisting of two valves operating in push-pull with associated tuning lecher wires in the grid, anode and filament circuits ; the dipole aerial was directly coupled to the grid circuit. Four of these units—eight valves in all—were used in parallel, all being kept in phase by an interlinking lecher wire system ; a formidable arrangement even by modern standards ! All four dipoles of this arrangement were situated in a broadside manner at the focus of a five-unit fishbone parabolic reflector. A conservative estimate of the effective radiated power of this particular arrangement is 4kW. Frequency modulation of the transmitter was obtained by the simple expedient of modulating the anode negative potential. The receiver consisted of a pair of push-pull valves connected in the Barkhausen-Kurz manner and used in conjunction with a paraboloid aerial. The radio-frequency " detector " was followed by a two-stage audio-frequency amplifier—only four valves in all. The secret of the success of this remarkable little receiver undoubtedly lay in the fact that, by patient and cunning manipulation of the grid and anode potentials, and the grid, anode and filament tuning lecher wires, the receiver could be coaxed to the state where it just failed to oscillate on the required frequency ; this state was superbly sensitive, as users of orthodox regenerative receivers will recall with some nostalgia.

It was with this apparatus, crude by modern standards, that Marconi set out in 1932 supremely confident that he would yet again confound the physicists and mathematicians of the day who were of the opinion that communication beyond the horizon was an impossibility by means of microwaves, or, as they were then called, quasi-optical waves.

The first experiments[6] were carried out with the transmitter installed on the roof of the Hotel Miramare at Santa Margherita, on the Italian Riviera ; the receiver was located in the stern of the " Elettra." This arrangement gave an optical range of about 27km.

Observations made while the " Elettra " steamed away from the transmitter showed repeatedly that signals could be received up to about three or four times the optical range. The behaviour of the signal repeated from one day to the next, the salient features being that up to the horizon fading was shallow and slow, but beyond the horizon fading became deep and fairly rapid.

Tests were carried out a month or two later from Rocca di Papa (Rome), from a height of 700m, with the transmitting aerial array directed across the sea towards Sardinia. The receiver remained in the same position at the stern of the " Elettra." The optical range under these new conditions was about 90km.

Repeated tests again showed that microwaves could be reliably propagated to distances exceeding the optical range by two to three times. The behaviour of the signals conformed closely to those received from the lower transmitting terminal at Santa Margherita. During these experiments signals were received up to distances of 240km. Continuing this series of experiments Marconi conducted microwave tests from two elevated terminals—one at Rocca di Papa and the other at Capo Figari (Sardinia) at a height of 340m—separated by a distance of 270km, with an optical range over sea of 150km.

In these tests it was established by beam swinging that the angle of arrival of the signal was tangential to the horizon and in the direction of the transmitter. Furthermore, for the duration of the tests, the signals were always present, albeit with notable fading.

Marconi was now well aware of the effects of meteorological conditions upon radio-communication, as is shown by Vanni.[7] He was of the opinion that the reception of radio waves at distances beyond the horizon could be attributed to the effects of the lower atmosphere. He was also convinced that some stratification would eventually be identified which would enable microwaves to be usefully propagated to distances of the order of 400–500km. With this in mind the supporting structures of both transmitting and receiving parabolic aerials were modified in a manner to allow the main aerial lobes to be elevated by substantial amounts. With this facility tests were carried out in the autumn of 1932 between Rocca di Papa and the " Elettra " anchored in the harbour at Venice, a distance of 400km. The optical range in these particular experiments, because of intervening hills, was restricted to 70km. Reception tests were made while the transmitting and receiving parabolic aerials were synchronously tilted upwards by successive small angles of elevation.

The experiment failed—probably because the distance was too ambitious considering the relatively low power radiated. On the other hand the author, who was responsible for the instrumentation of the test, has never been able to satisfy his conscience that the receiver and transmitter were ever brought into tune with one another. It was, in fact, the first time that an attempt was made to receive signals over a great distance without first being able to commence the experiment in the vicinity of the transmitter, where the tuning procedure was relatively easy and certain.

After the failure of the Rocca di Papa–Venice experiments great efforts were made to increase the power of the transmitter and the general stability and efficiency of the apparatus. The resulting improvement was so effective that Marconi decided to carry out further propagation tests with the " Elettra " in August, 1933.

The new transmitter was installed again at Santa Margherita. The " Elettra," with the receiving aerial installed at the stern, then steamed in a south-westerly direction along the Italian coast. Signals were monitored continuously during the voyage, and, apart from the occasions when navigational requirements made it impossible to maintain the receiving parabolic aerial directed towards the transmitter, signals were received throughout the voyage as far as the harbour of Santo Stefano. The total distance covered was 258km, i.e. nine times the optical distance. This distance was achieved in spite of the fact that high hills intervened at two points along the route.

Carroll[8] has recently pointed out that this particular experiment indicated, without doubt, that Marconi had discovered experimentally the existence of microwave propagation beyond the horizon which could not be explained by diffraction and refraction. This was the identical point of view expressed by Marconi[9] himself in the account he gave of the experiment to the Physics and Mathemat cal Section of the Royal Academy of Italy on August 14, 1933.

Sir Ambrose Fleming[10] has emphasised that Marconi's predominant interest was not in purely scientific knowledge *per se*, but in its practical application for useful purposes. So it was typical of Marconi that, having proved to his own satisfaction that microwaves could be utilised for all manner of purposes, he set about developing and demonstrating some of the practical applications. Amongst these applications were specific naviga¹ional aids,[11] which imposed a heavy demand upon the services of the " Elettra," and precluded her further participation in propagation experiments. Had it not been for this, the propagation tests would undoubtedly have continued and our present knowledge of tropospheric mechanisms might well have been much more advanced.

Considered in retrospect there is surely every reason to believe that, by his repeated demonstrations that signals were receivable beyond the horizon, even up to eight or nine times the optical range on both 30 and 600 Mc/s, Marconi utilised the same tropospheric mechanisms which we ourselves are only now actively investigating. It is interesting to note furthermore that we are slowly coming to the same conclusions that Marconi reached in one of his letters, written a quarter of a century ago.

REFERENCES


[1] Marconi, G., " Phenomena Accompanying Radio Transmission," *Marconi Review*, 1931, No. 32, page 1.

[2] Uda, S., Seki, T., Hatakeyama, K., and Sato, J., " Duplex Radio Telephony with Ultra Short Waves," *Journal of the Institute of Electrical Engineers of Japan*, 1931, 51, page 449.

[3] Pistor, W., " Reception of Ultra Short Electric Waves," *Zeitschrift für Hochfrequenztechnik*, 1930, 35, page 135.

[4] Clavier, A. G., and Gallant, L. C., " Anglo-French Micro-Ray Link between Lympne and St Inglevert," *Electrical Communication*, 1934, 12, page 222.

[5] " First Micro-wave Radio Telephone Service," *Marconi Review*, 1933, No. 40, page 29.

[6] Marconi, G., " Radio Communication by Means of Very Short Electric Waves," *Proceedings of the Royal Institution*, 1933, 27, page 509.

[7] Vanni, G., " Marconi's Recent Short-wave Tests," *Pontificia Accademia delle Scienze*, 1930, 83, page 216.

[8] Carroll, T. G., "Marconi's Last Paper 'On the Propagation of Micro-waves over Considerable Distances,'" *Proceedings of the Institute of Radio Engineers*, 1956, 44, page 1056.

[9] Marconi, G., (Translation by Fano, R. M.), "On the Propagation of Micro-waves over Considerable Distances," *Proceedings of the Institute of Radio Engineers*, 1956, 44, page 1057.

[10] Fleming, A., "Guglielmo Marconi and the Development of Radio Communication," *Journal of the Royal Society of Arts*, 1937, 86, page 41.

[11] Shankland, E. C., "Marconi's Wireless Pilot," *Nature*, 1934, 134, page 387.

## Sir Alexander Gibb—
## An Appreciation

LOOKING back over a link with Sir Alexander Gibb that has extended over fifty years, I am rather sensible of the modern shift in our attitude to life which tends to denigrate character and personality. People nowadays are conditioned to work impersonally in a spirit of teamwork which, admirable though it may be, seems to deprive them of those human and picturesque qualities which some of the older and less inhibited generation to which Sir Alexander belonged could and did display in such wide measure. These are qualities which in Sir Alexander's case have endeared him to many.

When I first knew him he was quite a young man but already in control of the oldest established and perhaps the leading firm of public works contractors in this country. He had on his hands simultaneously two of the biggest-ever dock construction jobs, which imposed upon him the necessity for extraordinary effort. He was of course a good practical engineer and himself a pioneer in the matter of contractors' plant and he was also a very shrewd business man. These abilities combined with a genius for making friends helped him along during the difficult years, but I think that what really counted most was his indomitable pluck, perseverence, and the great faculty he had for adaptation and resource.

At a later stage of his career this ability of his to size up a situation and come forward with just the right solution brought him well merited rewards. In 1914 for example it looked as if Rosyth Dockyard could never be got ready in time to take its proper place in the war but, through his friend Winston Churchill, he proposed an acceleration scheme whereby the Rosyth Base could be, and in fact was, made capable of provisioning and sheltering our fleet in the critical days that followed. Again a short time after that, when our armies in Picardy and Artois were hamstrung for lack of efficient transport behind the lines, it was Gibb and a small group of other civilians working under another friend Sir Eric Geddes who provided the remedy, Gibb's part in this being the provision of ports and train ferries.

Near the end of the war when the submarine menace looked like putting England out of action it was again Gibb who fathered the daring project of blocking the English Channel to submarines by establishing a line of artificial islands across the Straits, and although the chances of war prevented this scheme from coming to full fruition it was a great conception.

His resource and power of adaptation were not of course confined to expedients in wartime. One very notable instance of his peacetime planning ability lay in his recognition, in advance of almost all other engineers, of the important part which hydro-electric development of our apparently insignificant water resources might play in this country's electric power programme, and long in advance of the general movement he by his exertions in Galloway gave the country a convincing demonstration of this.

Another way in which Sir Alexander seems to have been thinking ahead of contemporary opinion was demonstrated by his abandonment after the 1914 war of the remunerative and assured position he could have occupied on the purely constructional side. This he did in favour of building up a consulting engineering organisation which for him was almost like starting life afresh. He no doubt perceived that whereas the old contracting firms like S. Pearson and Sons had in Edwardian days been the finest exponents of British civil engineering practice in lands overseas, the mantle was already falling from their shoulders and lighting upon those on the consultancy side of his profession. Sir Alexander's subsequent achievement in building up in Britain the world's largest and most well-known firm of civil engineering consultants was the outcome. Perhaps he had been influenced in doing this to some extent by the fact that he himself had from his earliest years been steeped in the best civil engineering tradition which Thomas Telford, helped by his own great grandfather, had first created—a tradition in which he himself followed so worthily.

GEORGE MAUNSELL

# Obituary

### W. T. BELL, O.B.E.

MR. WILLIAM THOMAS BELL, who died at his home at South Park, Lincoln, on January 27, at the age of ninety, had served the firm of Robey and Co., Ltd., continuously for over seventy years. He has been fittingly referred to as the oldest business man in Lincoln. There is an added distinction in that his father was a partner in the Robey organisation prior to the formation of the present company in 1893. Mr. Bell was educated at Lincoln School and at Mill Hill, and entered the Robey works as an apprentice in 1885. When his apprenticeship was completed, he spent some time in the design department and later went to Germany to take charge of a branch which the firm had opened in that country. In 1910, Mr. Bell was appointed a director of the company and four years later he became managing director. In 1922, he was elected chairman of Robey and Co., Ltd., which office he combined with that of managing director. Thus, he continued as the head of the company, with which he had served his apprenticeship, right up till the time of his death. Mr. Bell was a member of the Institution of Mechanical Engineers, his association with the Institution going back over sixty years for he was accepted as a graduate in 1890. He received the O.B.E. in 1918, and was a Justice of the Peace for the City of Lincoln.

### A. E. HUDD

IT is with regret that we have to record the death of Mr. Alfred Ernest Hudd at the age of seventy-five years on Friday, January 31. Probably outside railway engineering circles there were but few engineers to whom the name of Hudd meant anything until the day before his death, when the railway collision occurred at Dagenham on a section of line fitted with the system of automatic train control he introduced just before the war. Even then the system was possibly better known as the London, Tilbury and Southend system, for he retired in 1940. Mr. Hudd began his career as a pupil at the Harwich works of the former Lancashire and Yorkshire Railway, and later became interested in electric traction. After being concerned closely with the electrification of the Liverpool and Southport line, Mr. Hudd set up as a consulting engineer and signal specialist. In this capacity he served as a consultant to railway companies in America and Australia.

In 1933 Mr. Hudd became consultant engineer to the signal department of the former London Midland and Scottish Railway Company. After working on the development and improvement of signalling on the Fenchurch Street to Shoeburyness line of the company, during the course of which he developed his automatic train control system, Mr. Hudd retired from business in 1940.

### MAJOR F. H. MASTERS, O.B.E., T.D., M.I.E.E.

WE have learned with regret that Major F. H. Masters, who served technical journalism for more than fifty years, died at Welwyn Garden City on January 29, at the age of seventy-five. He was born at Hednesford, Staffordshire, and was educated at St. Paul's School and at Heidelberg College, Germany. After studying electrical engineering as a pupil of Silvanus P. Tnompson, at Finsbury Technical College from 1901 to 1903, he worked for a short time in the test room of the Foster Arc Light Company and then as a substation attendant on the Central London Railway. From 1904 to 1906 he served in the electrical engineer's department of H.M. Dockyard, Chatham.

He joined the staff of *The Electrician* (now *The Electrical Journal*) in 1906, as junior assistant to the editor, Mr. W. R. Cooper, and in 1910 he became chief assistant editor, a position he held until the outbreak of war in 1914. He was mobilised as a Subaltern, having been commissioned in the Territorial Army in 1910 after eight years' service in the Electrical Engineers (Volunteers), a body which was formed to supplement the Regular Army in the operation of coast defence searchlights. After being demobilised in 1919 he rejoined *The Electrician*, as editor. In February, 1927, he joined the editorial staff of our contemporary, *Engineering*, where he was mainly concerned with articles on electrical matters, until September, 1956, when he retired from full-time duties. His career with *Engineering* was interrupted during the second world war when he served in the Ministry of Economic Warfare and, later, on the Control Commission in Germany.

### SIR J. HOLLAND GODDARD

SIR JOSEPH HOLLAND GODDARD, whose death occurred, suddenly, in London, on January 30, had taken a prominent part in the affairs of the machine tool industry in this country. He was seventy-five. Sir Holland had for many years been actively associated with the business of Wadkin, Ltd., Leicester, of which he was president. He was a former chairman of the Imperial Typewriter Company, Ltd., and of the National Steel Foundry (1914), Ltd. On the day of his death, Sir Holland had attended a meeting of the Machine Tool Trades Association, of which he was a past-president. He was also a member of the management board of the Engineering and Allied Employers National Federation and of the Grand Council of the Federation of British Industries. He was created a Knight in 1949.

# LETTERS AND LITERATURE

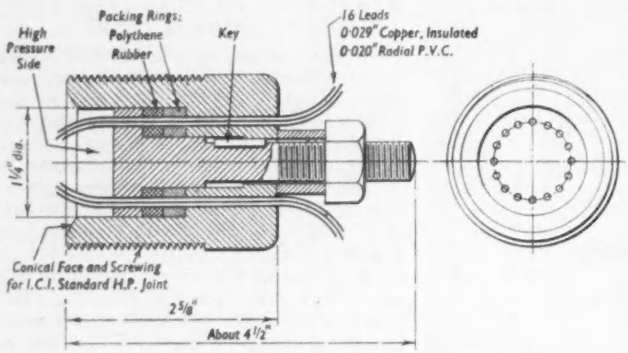
## Letters to the Editor

*(We do not hold ourselves responsible for the opinions of our correspondents)*

### NOTES ON THE USE OF RESISTANCE STRAIN GAUGES

SIR,—In the article under the above title in your issue of December 6, 1957, Mr. P. H. R. Lane discusses the use of electrical resistance strain gauges under pressure. Our experiences with them under these conditions do not entirely agree with his.

We have been working to a pressure of about 6000 lb per square inch. Two different sorts of gauges have both shown an appreciable change in zero due to pressure in the absence of strain, and moreover the change varies rather widely within a batch of gauges, as may be seen in the table below :—




**Unbalanced-area seal for sixteen insulated leads**

| Type of gauge | Number tested | Nominal resistance, ohms | Proportional resistance change at zero strain due to pressure of 6000 lb/in² | |
|---|---|---|---|---|
| | | | Mean | 95 per cent confidence limits for a gauge |
| Foil | 6 | 60 | $-1{\cdot}6\times10^{-4}$ | $\pm1{\cdot}3\times10^{-4}$ |
| Wire (flattened helix) | 5 | 200 | $-1{\cdot}1\times10^{-4}$ | $\pm2{\cdot}2\times10^{-4}$ |

The difference between the scatter shown by the two batches of gauges is not statistically significant so that there is no evidence that one type is better than the other. The pressure effect on any given gauge is linear with pressure within the limits of experimental error for the pressures reached in these tests.

If dummy gauges are placed within the pressure fluid, the metal on which they are mounted suffers a compressive strain, which in our particular cases produced resistance changes of the same order of magnitude as those due to pressure. This can and must be allowed for. The placing of dummies within the pressure fluid is, however, not recommended because to expose two gauges instead of one to pressure increases the uncertainty in the change of zero due to pressure. We have found an increase in sensitivity (gauge factor) with pressure of the order of 1 per cent for 6000 lb per square inch pressure. Double this pressure would therefore be required to make the increase comparable with the normal variation of gauge factor within a batch of gauges. In view of the widely different responses of electrical resistance strain gauges to pressure which are reported in the literature, the only safe course would seem to be to test each batch of gauges which are to be used under pressure.

We have not succeeded in making Mr. Lane's type of seal for bringing the leads out of the vessel entirely fluid-tight. We have therefore adopted an arrangement whereby the leads are brought out through the soft packing of a Bridgman type unbalanced-area seal, as shown on the attached sketch. The "Alkathene" disc under the rubber disc is essential to prevent the steel body cutting through the insulation of the leads. It is also essential to anchor the leads within the vessel to prevent the pressure expelling them through the seal. Copper cored leads are apt to be pinched off by the pressure within the rubber ring when the fluid pressure much exceeds 6000 lb per square inch, but leads of steel or "Nichrome" with a P.V.C. covering are satisfactory at 10,000 lb per square inch.

M. J. M RAYMOND
Imperial Chemical Industries, Ltd.,
Billingham,
Co. Durham,
January 23, 1958.

### "AN IDEA IN THE BATH"

SIR,—The article in your issue of January 24 will be of interest and value to many professional engineers, since it deals with a matter of importance which is often imperfectly understood. At the same time much of what your contributor writes is concerned with a situation in which no written agreement between the parties exists, or where such an agreement does not cover the ownership of patent rights. The inclusion of an express stipulation in an agreement in general excludes any implied term dealing with the same matter which the Courts might otherwise have inserted, and it is open to the parties at the time a service agreement is first drawn up to adopt any course they may think fit for determining the ownership of the fruits of the employee's inventions.

The wording of such a clause is a matter on which the Guild is frequently consulted by members, and whilst it is hardly possible to advise a form of words that will fit every circumstance there are two points which any prospective employee might well bear in mind. First, it is common for a service agreement to place the employee under an obligation to patent the discoveries he may make, or otherwise to secure protection for them, and to transfer to his employer the benefit of any rights which he may so obtain ; it is important to remember that these steps usually cost money, and to provide in the agreement that the employer will reimburse any expenses incurred.

Secondly, in order to avoid the experience of the research chemist in the recent case described in the article, it is desirable for the employer's right to be expressed as an option exercisable only within a specified period, and not as a presumptive ownership without limitation of time. It does not seem unreasonable that an employee should be entitled to enjoy the fruits of his ability where these, for one reason or another, are of no interest to the employer, but whether or not this view is accepted by the latter there is something to be said for having the position clear from the start.

J. G. ORR,
Secretary,
The Engineers' Guild
78, Buckingham Gate,
London, S.W.1,
January 27, 1958.

## Book Reviews

**Nuclear Chemical Engineering.** By M. BENEDICT AND T. H. PIGFORD. McGraw-Hill Book Company, Inc., 330, West Forty-Second Street, New York, 36, N.Y. Price 71s. 6d.

THE development of nuclear power has involved materials and chemical engineering processes which were little more than scientific curiosities until recently. Uranium, formerly used mainly for colouring glass and ceramics, is now an energy source of considerable and rapidly increasing importance ; gaseous diffusion, once meriting only a brief paragraph in physical chemistry text-books, is now the basis of very large plants which in the United States consume about 10 per cent of the national output of electrical energy. This book, of 594 pages, describes the materials of importance in nuclear fission reactors and the chemical and chemical engineering processes which have been developed for their separation and purification ; it is intended as a text-book for students and as a source of information about chemical engineering practice in nuclear technology. It is a valuable addition to the literature in that the subjects included have not previously been grouped together in one volume. The first chapter gives an elementary introduction to nuclear fission and the chemical and chemical engineering processes involved. Simplified flow sheets are presented for various reactor types. Nuclear reactions and fuel cycles are well treated in the two following chapters, with the sodium graphite reactor receiving the fullest discussion. The worked examples and flow sheets are particularly helpful ; this applies throughout the book.

The chapters on uranium and on other materials of importance in reactors (zirconium, thorium and beryllium) are less satisfactory as they are too brief and insufficiently critical; some processes of importance are not mentioned, and the information on uranium hexafluoride is rather inadequate and some-

what misleading. A notable omission is the absence of a section on graphite. Solvent extraction apparatus and calculation methods are treated reasonably fully, and the separation of zirconium and hafnium by the use of tributyl phosphate is dealt with in considerable detail ; however, the solvent, and techniques used in the British programme, are not described. Undue emphasis is given to algebraical methods of design instead of graphical methods, which are generally more convenient, especially for preliminary studies. The attempt at comparison of various kinds of equipment from results with different systems is of doubtful validity. No section is included on the heat transfer problems associated with nuclear reactors.

There is an excellent summary of the radioactive behaviour and the very complicated chemistry of irradiated fuel. The treatment of the separation of reactor products is less satisfactory. American processes are described fully, but the formidable difficulties associated with the non-aqueous processing methods appear to be under-rated. The principles involved in calculating safe sizes for vessels containing fissionable materials merit a fuller treatment than the few lines they have received. Although the problems associated with aluminium cladding are dealt with exhaustively, magnesium cans, which are important in the U.K. programme, are not mentioned.

The final four chapters on isotope separation are very complete and well presented. Deuterium and $U^{235}$ are dealt with in considerable detail ; lithium, boron, carbon, nitrogen and oxygen are only mentioned briefly, but full references are given for those interested in these elements. The principles of isotope separation have not previously been generally available except in a specialised book by Cohen. Separate chapters are devoted to isotope separation methods for light elements (mainly concerned with deuterium) and for heavy elements.

Each chapter is supplemented by a list of references (mainly American) for further reading, and by a well-chosen series of problems (without answers). The appendices include a useful table of isotopes, which would be improved by the addition of methods of formation and radiation energies. Indexing is accurate and thorough. The book is well produced, and few errors were noted. It may be confidently recommended as a text-book for students, although many will be unable to afford it at this price ; it is also suitable as an introduction to the field for chemical engineers. Those already working in the industry will find it useful, but the reservations must be made that the treatment of some subjects is inevitably sketchy in a general text-book, and that British processes are almost ignored.

**Brittle Behaviour of Engineering Structures.** By EARL R. PARKER. Chapman and Hall, Ltd., 37, Essex Street, London, W.C.2. Price 28s.

THERE are few problems in engineering metallurgy that have given rise in recent years to more investigation than the brittle fracture of engineering structures. Though brittle fracture of steel structures of one form or another has been a matter of concern for a century, attention was sharply focused on the subject by the epidemic of ship failures during the second world war. Since then exhaustive investigations have been carried out in Great Britain and in the U.S.A. This book, though primarily giving an account of the researches supported by the American Ship Structure Committee, is designed to cover the whole field of present day knowledge of the phenomenon of the brittle behaviour of metals and its manifestation in engineering structures.

The serious situation in the winter of 1942-43 led to immediate steps being taken in design to avoid hitherto unsuspected stresses in welded constructions, to a greater reliance on the notched bar impact test, and to a recognition of the effect of composition of the steel and especially the part played by manganese in lowering the transition temperature. The revived interest in the prevention of brittle failures opened up a succession of problems which awaited solution. Thus, the book deals with theories of fracture, varieties of test specimens and interpretation of test results, the influence of chemical composition and manufacturing practice, the role of welding and the effect of residual stress, before discussing welded ship failures and failures in steel structures other than ships. As would be expected, American investigations are more fully discussed but British work is not overlooked. Some important British contributions to the subject, however, receive no mention, and it may be suggested that the book be read in conjunction with the Admiralty Advisory Committee's report *Brittle Fracture Research in the United Kingdom* (H.M. Stationery Office, 1957).

The last chapter of Professor Parker's book consists of a summary of conclusions on which the remedial measures adopted in America are based. These have developed on parallel lines to those employed in Britain, e.g. attention to design, improvement in welding technique, avoidance of residual stress and control of the notch toughness of the parent steel. Unfortunately the application of some of the most effective means of lowering the transition temperature is impeded by economic considerations.

It should be mentioned that the material of the " engineering structures " dealt with in this book is mild steel or low alloy steel. Though much of the fundamental work on brittle fracture may apply to other metals, the behaviour of large structures in, for example, a high-strength aluminium alloy would require an independent but equally searching examination.

**Engineering Metallurgy.** By RAYMOND A. HIGGINS. English Universities Press, Ltd., 102, Newgate Street, London, E.C.1. Price 25s.

THIS book has a sub-title, " Applied Physical Metallurgy," and covers Part I of the subject. It is to be followed by a companion book, Part II, " Metallurgical Process Technology." It is intended chiefly for the use of students taking metallurgy as an examination subject for a Higher National Certificate in Mechanical or Production Engineering. The author hopes that it may also prove useful to undergraduates studying metallurgy as an ancillary subject in an Engineering Degree course ; and that, to students for whom metallurgy is a principal subject, the book will offer a helpful approach to certain sections of the work in preparation for the Higher National Certificate and the City and Guilds Final Certificates in Metallurgy. It should be noted that, in Chapter 1, the basic principles of chemistry are so covered as to enable readers to follow the study of engineering chemistry without being at a disadvantage if they have not previously studied chemistry as an independent subject.

The book, which is a singularly clear, comprehensive and altogether admirable exposition, is one which the metallurgical student has simply got to buy, even if he has to go hungry in order to do so ! The chapter headings are : chemistry ; metallurgy and the engineer ; production of iron and steel ; physical and mechanical properties of metals and alloys ; crystalline structure of metals ; effects of mechanical deformation and recrystallisation ; industrial shaping of metals ; plain carbon steels ; formation of alloys ; thermal equilibrium diagrams ; practical metallography ; heat-treatment of plain carbon steels (two chapters) ; alloy steels ; complex ferrous alloys ; cast irons and alloy cast irons ; copper and copper-base alloys ; aluminium and its alloys ; other non-ferrous metals and alloys ; surface hardening of steels ; machinability of metals and alloys ; metallurgical principles of the joining of metals ; metallic corrosion and its prevention ; methods of measuring temperature. Each chapter is followed by a number of exercises which the student should undertake, and also by a number of recent examination questions on the particular subject. There are thus 132 exercises and 369 questions in all. Nearly all the questions are taken from the final examination papers (A2) for the Higher National Certificates in Engineering, the name of the College being always appended. The subject matter of the chapter should enable the student to deal adequately with any of these.

The book has a number of noteworthy features. The diagrams and their explanations are strikingly clear, and those illustrating the successive stages of a process are very good indeed. Among such are those depicting the dendritic growth of metallic crystals and the development of porosity in cast metals (page 74) ; the mode of formation of mechanical twins (page 86) ; the stages in the recrystallisation of a cold-worked metal (page 89) ; the micro-constituents at different compositions and temperatures in iron-carbon alloys (page 113) ; a similar pictorial representation of the cooling of tin-lead alloys (page 138) ; the progressive coalescence on annealing of the cementite in pearlite (page 177) ; the structural effects of heating a steel casting to the top of its critical range, followed by slow cooling (page 179) ; the diagrammatic representation of the method of constructing T.T.T. curves (page 193), and the structural changes in stainless steels leading to " weld-decay " (page 218). There are a great many most detailed tables. Those covering etching reagents (pages 153-154) give the type, composition, characteristics and uses of eighteen etchants for irons, steels and cast irons, copper and its alloys, aluminium and its alloys, and miscellaneous alloys. The four tables devoted to aluminium and its alloys (pages 294-307) cover the wrought and cast alloys, not heat-treated and heat-treated, respectively ; under the headings of ; relevant specifications (ninety-five in all), proprietary alloys, composition, typical mechanical properties and uses.

The scope of the book is so wide that it is inevitable that a number of minor errors, discrepancies and omissions should be found. In revision for a second edition, which should speedily be called for, these matters should be attended to. Thus, the fundamental physical qualities should be defined more specifically and the same term should not be used to denote different qualities. Toughness is defined on page 50 as " the ability to withstand bending or the application of shear stresses without fracture." On page 58, it is defined as " the capacity to resist shock," and is said to be measured by the Izod test. In

discussing this test, the author makes no mention of the fact that, although impact is used in this test, comparable values for most materials can also be obtained on notched bars by slow bending. Most people would regard toughness as synonymous with ductility, which is defined (page 49) as "the capacity to undergo deformation under tension without rupture." It could be described more precisely as the quality shown by materials which, when progressively loaded, do not break suddenly, but show considerable plastic extension *before* fracture. Hardness is not defined at all, although a number of ways of measuring it are described (page 55). The author says, of mild steel, that, at the yield point, a sudden extension takes place with no increase in load, but the load-extension curve (page 51) does not show the necessary horizontal line to denote this ; nor is there any reference to the upper and lower yield point in mild steel. On page 62, it is said that the fatigue curve, relating stress to number of reversals, becomes horizontal at a stress which is known as the fatigue limit or endurance limit ; but the typical fatigue curve on this page does not show this. The typical fatigue fracture (page 63) is said to consist of two parts, one being quite smooth and burnished, showing ripple-like marks radiating outwards from the centre of crack formation (as is of course perfectly correct) ; while the other portion, indicating the final fracture of the remainder of the cross-sectional area, which could no longer withstand the load, is said to be "coarse and crystalline." The final tear is coarse, but is always fibrous, and certainly never looks crystalline ; although it may sometimes be damaged, by the two broken pieces knocking together after fracture. It will be appreciated, of course, that steel is actually always crystalline ; and the terms "crystalline" or "fibrous" describe only the *appearance* of the fracture.

Non-d structive testing (page 63) covers only the magnetic dust and radiographic methods. Ultrasonic and fluorescent inspection, and the various electrical inspection methods, should be referred to. The "gamma loop," and the alloy elements which tend to stabilise ferrite, are discussed on page 205, and the compositions of two high-chromium ferritic steels are given in a table of heat-resisting steels on page 225 ; but the particular advantage of these steels is not referred to. They have been used almost exclusively for British jet engine discs ; because, although inferior in creep resistance to the more expensive austenitic steels at the higher temperatures of 650 deg. to 800 deg. Cent. at the lower temprature range of 350 deg. to 500 deg. Cent.—such as can be obtained by suitable cooling of the rim of the disc—their creep strength is apppreciably higher, and the disc can therefore be correspondingly thinner and lighter ; this constituting one of the reasons for the superiority of British jet engines over those in the rest of the world.

The Decimal System of Classification is used in numbering both the sections of the chapters, and also the illustrations ; these comprising both plates and figures, numbered independently. Since both plates and figures sometimes consist of two or three separate parts, designated by letters, there is often a very odd sequence of illustrations—such as Fig. 10.1, Fig. 10.2 (A and B), Plate 10.1 (A and B), Fig. 10.3 (A, B, C), Fig. 10.4, Plate 10.2. This makes it very difficult to find quickly the particular illustration referred to. The Decimal System, although essential for the classification of books in a library, seems ill-adapted—at any rate in the form used—for numbering book illustrations. These minor criticisms must not be regarded as detracting seriously from the solid worth of this book ; which, as already indicated, cannot be recommended too highly.

**Engineering Insurance.** By R. H. PROCTER, M.I.Mar.E. Ist Edition. Sir Isaac Pitman and Sons, Ltd., 39, Parker Street, London, W.C.2. Price 30s.

As the author acknowledges in his preface, "the majority of students who need to know something about engineering insurance are not engineers, and it is not essential to be a technician in order to understand the principles and practice of this class of business." The treatment of engineering matters in the book is simplified accordingly, and suffers a little as a result in the eye of the technical beholder. One or two instances will suffice. There is a chapter entitled "Steam Engines" which, after about half-a-dozen lines of introduction, sums up under the heading "History" the work of inventors from Alexandrian Hero to George Stephenson (spelt, alas, with a "v") and beyond, taking little more than half a page in the process. The next heading is "Description of a Steam Engine, and the illustration below this shows the "combined engine and boiler" constructed by Hero in about 150 B.C. "The first essential part of a steam engine," the description begins, "is the cylinder. This has a smooth circular bore which is fitted with a piston." The reader may search in vain for these essentials as he studies the nearby picture of Hero's primitive turbine. The critic may also wonder what the completely non-technical reader will understand from such a phrase as "a smooth circular bore which is fitted with a piston." It is for the very reason that the users of this text-book are likely to be non-technical that the descriptions of engineering hardware should be clear and free as far as possible from jargon. Where technical terms are unavoidable they should be explained. In fact, a book with the objectives declared for this one might well include a comprehensive glossary.

The book is issued under the authority of the Chartered Insurance Institute, and the author is himself superintendent of claims for an insurance company, so that the engineer who wishes to enlarge his knowledge of insurance will probably be able to skim the technical matter without a qualm, and derive the appropriate benefit from the text. Its intended target, those who are preparing for the examinations of the Chartered Insurance Institute, will find the book more valuable if they have already a smattering of technical knowledge.

## Books Received

*Gas Turbine Materials.* By G. Lucas and J. F. Pollock. Temple Press, Ltd., Bowling Green Lane, London, E.C.1. Price 25s.

*Metallurgical Aspects of the Control of Quality in Non-Ferrous Castings.* The Institute of Metals, 17, Belgrave Square, London, S.W.1. Price 35s.

*The Coal Industry of the U.S.S.R., Part 2 : 3. Mine Hazards.* National Coal Board, Hobart House, Grosvenor Place, London, S.W.1. Price 2s.

*Dynamic Instability : Automobiles, Aircraft, Suspension Bridges.* By Y. Rocard. Crosby Lockwood and Son, Ltd., 26, Old Brompton Road, London, S.W.7. Price 45s.

*Recruitment to Skilled Trades.* By Gertrude Williams. Routledge and Kegan Paul, Ltd., Broadway House, 68-74, Carter Lane, London, E.C.4. Price 23s.

*History of the British Iron and Steel Industry.* By H. R. Schubert. Routledge and Kegan Paul, Ltd., Broadway House, 68-74, Carter Lane, London, E.C.4. Price 60s.

## Technical Reports

*Forest Products Research Bulletin No. 41 : The Strength of Nailed Joints.* D.S.I.R. H.M. Stationery Office. Price 2s. 6d.—This report is concerned with the strength of nailed timber joints in which the nails are subject to lateral load, i.e. the loads or forces in the members joined act in a direction perpendicular to the longitudinal axis of the nails. The nails under consideration are the round chequered-headed wire nails without surface treatment commonly used in timber construction and they were driven perpendicularly into the side grain of the timber without drilling. The experimental work described includes tests to compare the strength of joints with nails in single and double shear. The dependence of joint strength on the number and diameter of the nails, thickness of the members, specific gravity and moisture content of the wood and the direction of loading with respect to the grain of the wood, is examined. Empirical equations are developed in which the maximum load which can be sustained by a joint and the loads to cause particular slips in a joint are expressed in terms of the specific gravity of the wood and the diameter of the nail. Although only one species of softwood was used in the tests, it is assumed that the essential data will apply to softwoods generally. The equations, together with other results of the investigations, are therefore used to develop permissible lateral loads for nails in single and double shear in various softwood species.

*The Strength of Annealed and Heat-treated Glass.* By F. G. J. Brown, B.Sc., A.F.R.Ae.S., and J. Ellis, B.Sc., A.M.I.Mech.E. Reports and Memoranda No. 3003. H.M. Stationery Office. Price 10s. 6d. —This report develops statistical methods of choosing allowable design stresses for annealed and heat-treated glass. The results are easy to apply but additional fundamental knowledge of some properties of glass is needed before they can be used to the best advantage. The report draws attention to these gaps in existing knowledge and makes recommendations for further research.

The report discusses the influence of the known causes of strength variations between nominally identical specimens in relation to two types of glass typical of those used by the aircraft industry, and shows that improved control of heat-treatment processes offers the best hope of a big increase in the useful strength of glass. Chemical protection of the glass surfaces, or changes of composition which increase the intrinsic strength and chemical stability of the glass, would increase the useful strength of both annealed and heat-treated glasses. The potential benefits for heat-treated glass are small compared with those obtainable by improved control of the heat-treatment processes but are nevertheless important.

*Atlas Métallographique de Microstructures-Types.* Issued by the Centre Technique des Industries de la Fonderie. Editions Techniques des Industries de la Fonderie, 12, Avenue Raphaël, Paris (16e). Price, F.fr.1100.—The macro- or micrographic examination of metallic samples allows deductions as to the influence of chemical composition, method of preparation and heat treatment on the mechanical and other physical properties of an alloy. This method is therefore of considerable theoretical as well as day-to-day practical interest. The non-special technician can, however, easily be baffled by the appearance of a micrographic section with which he is unfamiliar. For that reason the Centre Technique des Industries de la Fonderie has collected a series of typical micro-structures in the form of an album. These were chosen from the point of view of their importance ; the collection is accompanied by some practical information about the preparation of samples and the most widely used methods of approach.

*Flight Tests on a "Vampire" Mk. 5 with a Redesigned Anti-Snaking Rudder.* By W. J. G. Pinsker. Reports and Memoranda No. 3014. H.M. Stationery Office. Price 5s.—A specially designed rudder has been fitted to a "Vampire" Mk. 5, to act as an aerodynamic yaw damper. Flight tests show that the damping of the lateral oscillation has been substantially increased in consequence, a logarithmic decrement greater than unity being attained even at 40,000ft altitude. This is a considerable improvement on the results obtained previously on the same aircraft, when the standard rudder was used as the damping surface. Air-to-air aiming is shown to have benefited from the effect of the damping rudder.

*Die Auswertung von Seismischen Refraktionsmessungen in Einem Einachsig Inhomogenen Körper mit Abgebrochenen Potenzreihen.* By Max Weber, Mitteilungen aus dem Institut für Geophysik, No. 31. Eidgenössische Technische Hochschule, Institut für Geophysik, Leonhardstrasse 33, Zürich 6. Free on application.—This paper, which has previously appeared in Geofisica Pura e Applicata, Milan (1956), Vol. 35, pages 14 to 24, interprets the seismic travel-time surfaces for refracted rays in the form of power series with a finite number of terms. The result is applied to two typical examples. Finally, the Herglotz solution is given in a new form.

# Industrial Gas Turbo-Alternator

FOR many years, Richardsons Westgarth (Hartlepool), Ltd., as the firm is now styled, has manufactured under licence from the Swiss engineering firm of Brown Boveri steam turbines, alternators, blowers and compressors. In 1954 the company, realising the success which Brown Boveri was attaining in the field of gas turbines and believing that there was a potential market in this country for gas turbine sets, particularly in steel works, decided to take out a licence for the manufacture of gas turbines of Brown Boveri design. The first order to come within the new licence was obtained from Shelton Iron and Steel, Ltd., for a power producing unit. This particular unit will be the first such engine to be installed in a steel works in this country.

It was originally specified that the machine, at normal ambient conditions of 60 deg. Fah. and 14·7 lb per square inch absolute, should be capable of an output of 2500kW at the alternator terminals. From the brief tests carried out so far, it is apparent that this output can easily be obtained at temperatures well below the maximum permissible before the turbine, namely, 650 deg. Cent. The alternator and gearing are rated for a peak output of 3200kW and additional power will be available without the maximum temperature before the turbine being exceeded

The gas turbine proper follows the accustomed methods of heavy turbines resembling steam plant. The cycle is simple except for the use of heat exchangers, two for the air and one for the blast-furnace gas when used as fuel. The gas ducting is consequently complex ; much of it is installed below the level of the rotating machinery. A refinement is the incorporation of soot blowers in the recuperators: the small tubes through which the gas passes are vertical and arranged inside a cylindrical casing ; opposite the lower ends of the tubes an arm carrying nozzles facing the tubes can be revolved to sweep the entire bank. The nozzles are charged with clean air by the compressor, and it is claimed that this system of soot-blowing when the engine is unloaded is effective.

For occasions when no or insufficient blast-furnace gas is available, the vertical reverse-flow combustion chamber is provided with a retractable oil sprayer; this item calls for a special supply of cooling air, which is continued after shut-down by a fan. The oil fuel is supplied at constant pressure, flexible hoses being required, and the flow regulated by a pintle moved by a large hydraulic ram mounted on the top of the combustion chamber. A retractable igniter consisting of a metal rod raised to red heat by electricity is provided; there is a pilot supply of blast-furnace gas to the igniter. A small part of the compressor delivery air is not mixed with the products of combustion in the chamber but passes outside the duct lining to the outside of the heat shields in the turbine intake space, and is then led over the ends of the first stage nozzle vanes. The control system maintains constant shaft speed up to a predetermined maximum gas temperature and, for further increases of load, constant turbine inlet temperature, corresponding to a fairly sharp decrease in power. When the plant is shut down, the lubricating oil pump runs at half speed and the engine is intermittently barred over ; this system runs on alternating current, and for safeguard against a supply failure a d.c. oil pump is fitted to supply cooling oil to the turbine bearings.

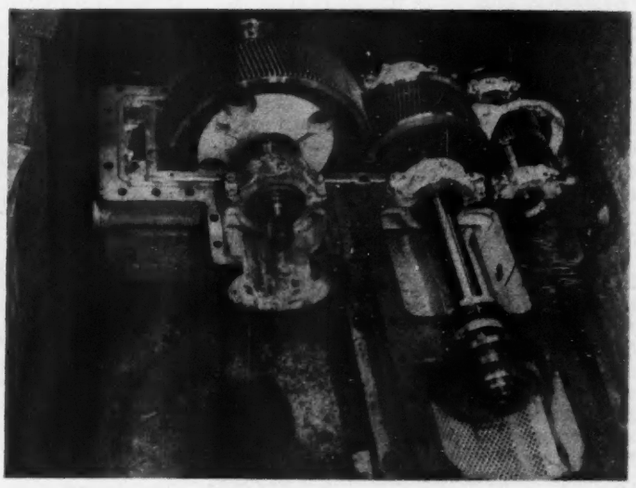
The principal auxiliaries and the alternator are driven through a set of gears which for, this machine, were manufactured by Brown Boveri. Three wheels run in mesh, the turbine (5350 r.p.m.) in the centre, the gas compressor (7970 r.p.m.) and the motor and generator (3000 r.p.m.) on each side. Single helical teeth are used, and end thrust is developed on the rims of the wheels ; since the loading on the electric plant reverses, a collar for this purpose is necessary on both sides of the turbine pinion.

Previous Brown Boveri steel works engines have handled larger flows of blast-furnace gas than this machine, and no axial flow compressor was available to aspire the gas. A six-stage centrifugal compressor is therefore employed, with diffuser blading that is described as "fixed adjustable," it being possible to vary the work done between stages by an adjustment in the workshop. The pressure ratio is close to that of the air compressor, i.e. 4, the gas supply being at a slight positive gauge pressure. The glands of the compressor are exhausted by an auxiliary fan to remove a potentially dangerous mixture with air. The blast-furnace gas system is somewhat complicated; the engine is controlled by by-passing air back from compressor delivery to intake, and to prevent the control system having to deal with rapidly changing compressor intake conditions a cooler is provided in this by-pass. Since the gas contains both dust and moisture, it is considered necessary to keep the temperature at intake to the compressor above 30 deg. Cent. to prevent fouling of the compressor, so there is also a gas heater on the low pressure side of the compressor. The heat exchanger, similar to but smaller than one of those for the air, is, of course, additional. When oil fuel only is available, the centrifugal compressor supplements the air flow.

A slipring induction motor giving 142kW at 1000 r.p.m. is coupled to the low-speed gear; it is rated for three starts in succession. When the turbine is running under its own power, the brushes are withdrawn from the sliprings by an electrically-driven mechanism. To the far end of the motor is connected the alternator and its exciter ; this asembly is a standard unit running at 5·5kV, and when installed will use a closed circuit air cooling system. An overall thermal efficiency of 20·5 per cent has been guaranteed.

Since obtaining the order for the Shelton gas turbine the company has obtained two further orders, each for two units, from British Brown Boveri (for the Kuwait Oil Company) and from the Pakistan Industrial Development Corporation. The Kuwait units will have a terminal output of 7500kW at an ambient temperature of 50 deg. Cent. and a maximum output of 10,500kW at 30 deg. Cent. and those for installation in Pakistan will have a terminal output of 5700kW at an ambient temperature of 40 deg. Cent. All these units will operate normally with a natural gas fuel.

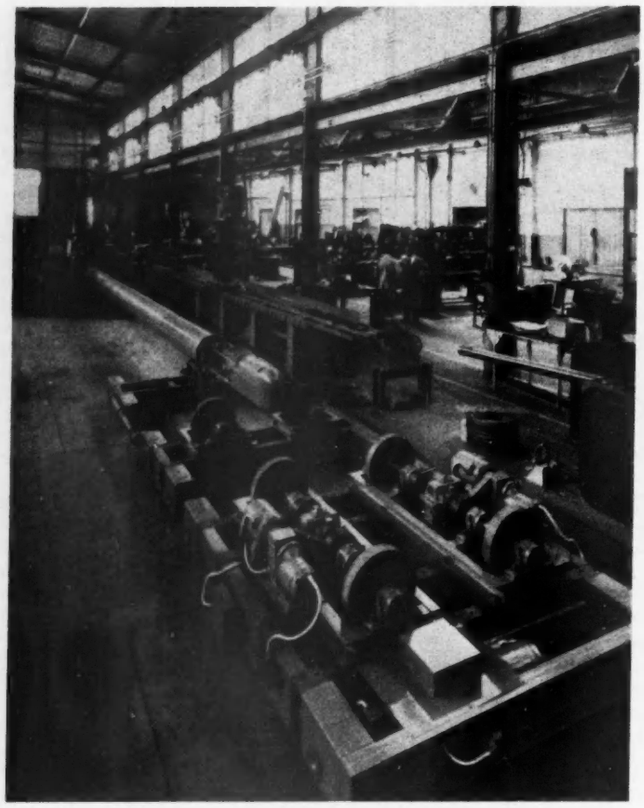
The Hartlepool company, in order to cope with the increased volume of business in the land turbine field, has in hand a development programme involving expenditure of approximately £1,750,000 for the extension of its manufacturing, erection and testing facilities for turbines and alternators. These extensions, which will be completed by the end of this year, will enable the company to manufacture and handle the largest turbo-alternator sets now envisaged. They form part of the current development programme of the Richardsons Westgarth Group.



**(Left) The blast-furnace gas compressor and the main electric components : the electrically-driven brush withdrawal mechanism is on the left hand end of the starter motor. (Right) The main gear train in course of assembly : notice that the thrust developed by the helical gears is not communicated to the casing**

# Continuous Welded-Pipe-Making Equipment

*A plant for making welded steel pipes, which has been installed at the Coatbridge works of Stewarts and Lloyds, Ltd., is designed to take pre-formed steel sheet, roll the flat edge sections to the required curvature and then weld the longitudinal seam in a continuous operation. This plant, supplied by Quasi-Arc, Ltd., is of Torrance design and on it the longitudinal seam is welded by "Unionmelt" automatic equipment. A special boom welding equipment illustrated on the right has been supplied for use when an internally welded pipe is specified. A television monitor on this boom adjacent to the welding point enables the weld to be observed continuously, as it is made, from the operator's control panel.*



A WELDED pipe-making plant of Quasi Arc/Torrance design, and fitted with "Unionmelt" automatic welding equipment, has been installed by Quasi-Arc, Ltd., at the Coatbridge works of Stewarts and Lloyds, Ltd. This plant is built for the continuous closing and welding of pre-formed steel pipes in size range 18in to 50in diameter in plate thicknesses up to $\frac{5}{8}$in. Welding speeds of 30in per minute in the case of $\frac{5}{8}$in thick material, to 96in per minute on material $\frac{3}{16}$in thick, are possible. With it there has also been supplied a new form of boom welder, which is fitted with a television monitor, and is used for internal welding of pipes when specified.

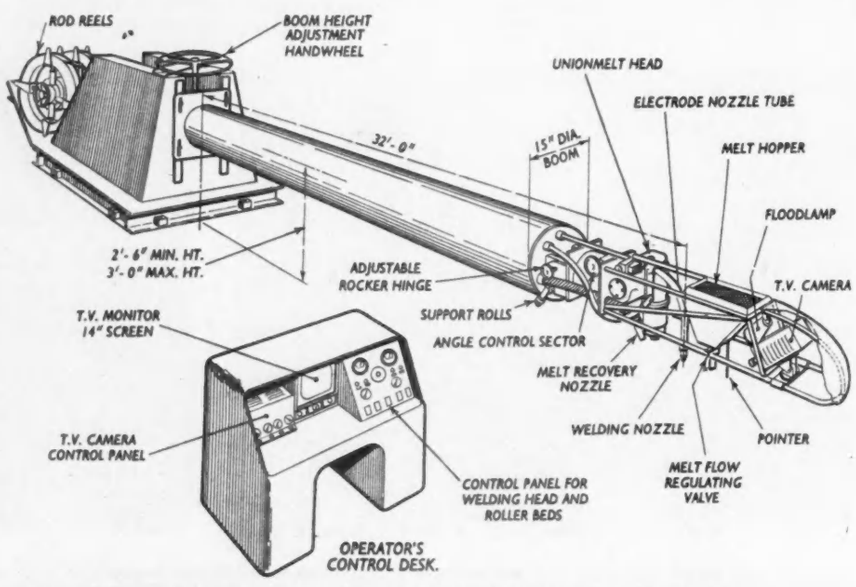
Quasi-Arc/Torrance equipment is designed to take advantage of the speed and economy with which steel plate can be pre-formed into cylinders on standard rolls or presses for pipe making purposes. This class of pre-formed cylinder normally has a disadvantage when required for making longitudinally butt welded pipes in that the metal is left flat and unformed up to a few inches back from its longitudinal edges. On the Quasi-Arc/Torrance machine these edges are first rolled to the correct curvature during a continuous in-feed movement and then held together for continuous welding. The general construction of the machine can be seen in the illustrations on this page.

The pre-formed pipe length is fed into the rear end of the machine where it is supported on a roller bed below floor level. A slitter bar or plate which projects down from the main upper framework of the machine registers in the longitudinal gap along the pipe. A short distance in the machine the pipe edges are gripped between the first two pairs of four sets of drive and backing rolls, on each side of the slitter bar. These rolls are profiled to impart progressively the correct curvature to the unformed edges of the pipe, and the upper driving rolls are driven through chains by a motor and reduction gear unit mounted on top of the frame. As the pipe is drawn along in the machine a series of thrust rolls along beams on each side press the pipe inwards to maintain the pipe central with respect to the slitter bar and in correct register in the forming rolls.

At the outgoing end of the roll forming section of the machine the pipe passes into a cage consisting of ten lines of "crimp" or closing rollers carried in channel bars and held rigidly in position by arms extending inwards from two annular ring assemblies. This closing mechanism closes the gap between the pipe edges whilst they are continuously welded together by a "Unionmelt" equipment carried on a frame above.

As already mentioned, the machine is designed to continuously weld pipes from 18in to 50in diameter and incorporates the necessary wide range of adjustments for the drive and backing rolls, the thrust rolls and the closing rolls. Several sets of drive and backing roll assemblies are provided, each set covering a variation of about 6in in pipe diameter. The closing roller cage can be adjusted to suit any pipe diameter over the range, but for pipes below 30in diameter two of the ten lines of closing rollers are removed to provide for the reduced space available.

The "Unionmelt" equipment comprises two "D.S.H." automatic welding heads arranged for scratch start and supplied

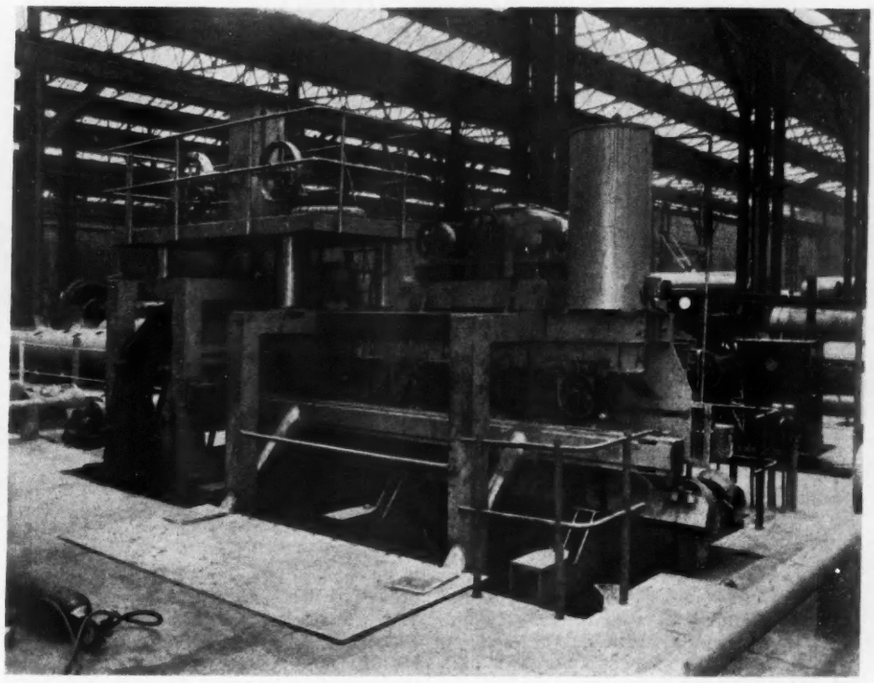



**Diagrammatic arrangement of boom and controls for internal pipe welding equipment**

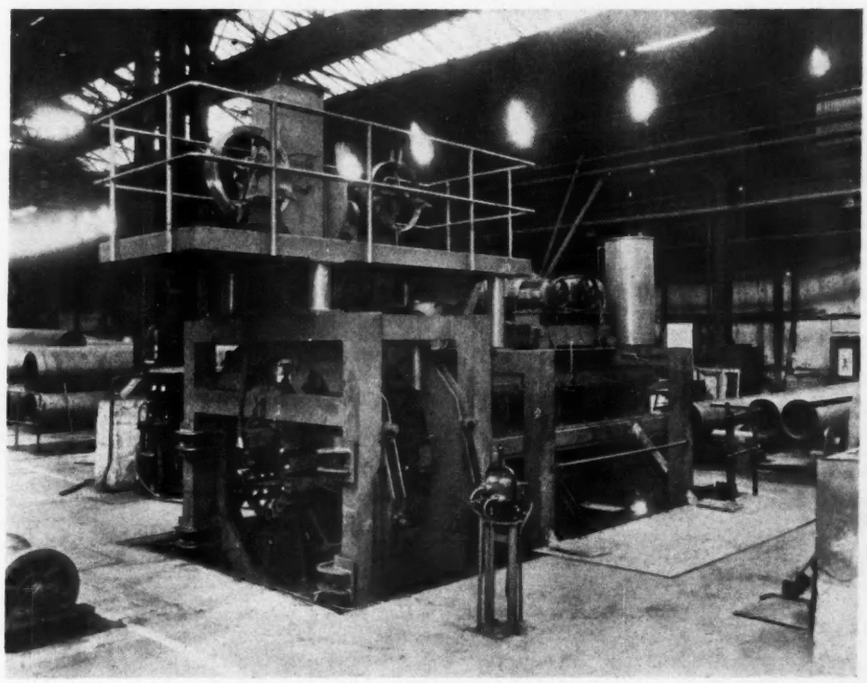
with current from a 1200A a.c. rectifier and 1000A transformer respectively. The rod reels and the melt supply and recovery equipment serving these heads are mounted on a platform above the welding station of the machine.

The welded pipes pass out of the machine on to a roller bed from which they are transferred to storage racks. When, however, it is specified that the longitudinal seams shall be welded inside as well, the pipes are passed on to an internal welding section where the boom welding equipment shown in the accompanying diagram is installed. This welding equipment has a 15in diameter boom, which enables it to handle the smallest sizes of pipes made on the Quasi-Arc/Torrance machine, and is sufficiently long to weld pipes up to 30ft in length. During internal welding the restricted diameter of the pipe makes it impossible for an operator to control the equipment by direct visual observation of the weld zone, and to overcome this difficulty a closed-circuit television set is incorporated.

This internal welding equipment consists essentially of a rigid fabricated support structure in which heavy slides support the tubular steel boom. Through these slides the boom has a vertical adjustment of 6in by handwheel control, to provide for varying pipe thicknesses and pipe diameters. At the operative end the boom carries a "Unionmelt" D.S.H. automatic welding head mounted on an angle



**Pipe infeed end of continuous pipe welding machine. The slitter bar and edge forming rolls can clearly be seen and the closing rolls are on the inside of the beam in front of the lower sets of forming rolls**



**Outgoing end of machine. The annular cage of closing rolls is retracted beneath the welding equipment and the melt receiving hose is immediately beyond**

control sector and fitted with a parallel welding nozzle. Wire is fed to the head from twin reels on the support structure at the end of the tubular boom. Melt is fed ahead of the welding nozzle from a 50 lb capacity hopper and a second nozzle behind the head is coupled to an external melt recovery unit. A television camera on a universal mounting installed at the leading end of the boom is directed on the welding zone which is illuminated by a 150W photo-flood lamp. A pointer in front of and in line with the welding nozzle is used to follow the seam in front of the melt flow. The camera provides a picture of this pointer in relation to the seam so that any deviation from the line can be immediately seen by the operator on a 14in monitor screen at the control desk.

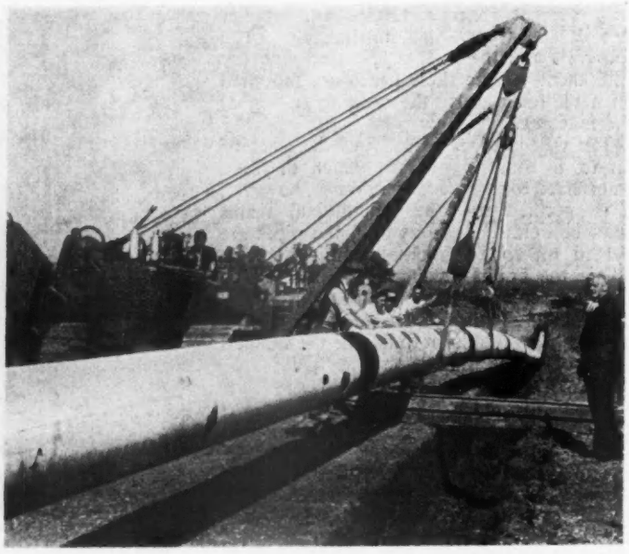
At its outer end the boom is fully supported between welding operations by a roller mounting carried by a rail bogie. This bogie is freely mounted on rails below the full length of the boom and it is pushed rearwards by the leading edge of a pipe as it is fed on to the boom during the welding cycle. As the bogie moves back, the end of the boom is supported directly from the inside surface of the pipe through a pair of bracket-mounted spherical support rollers situated immediately behind the welding head assembly. The pipes are fed on to the boom by longitudinal travel of rail-mounted roller beds which can be moved at infinitely variable speeds from 15in to 90in per minute for welding, and retracted at 20ft per minute at the end of the welding cycle.

The roller supports of the pipe beds are power driven and controlled from the panel adjacent to the monitor screen on the main control desk. As welding proceeds along the seam any deviation from the line, which is shown on the monitor screen, is corrected by the operator turning the pipe through the necessary angle by the support roller drive controls.

**Control panel for internal welding set, with television screen for observing progress of weld**

# Shellhaven–Romford Gas Pipeline

*Increasing demands for gas, together with the rising price and reduced availability of good carbonisation coals, caused the North Thames Gas Board to search for new raw materials and to adopt new methods for making gas. It was decided to use refinery-produced gases of high calorific value and reform them for use in the grid. The scheme has involved the laying of a pipeline from Shellhaven to Romford and the construction of a reforming plant at Romford. The photograph which we reproduce on the right shows the pipeline being laid.*



THE North Thames Gas Board is responsible for an area of 1059 square miles, lying mainly north of the Thames from High Wycombe to Shoeburyness, and uses over 5,000,000 tons of coal and nearly 23,500,000 gallons of oil to produce more than 389 million therms of gas a year. Because of the exceptional nature of London the Board has a difficult load factor and is constantly seeking methods to improve it. Supplies of carbonisation coals, which come from the north-east coast, have been steadily increasing in price relative to coals used by other industries, due to the greater demand for gas and the increasing supplies of coal suitable for steam raising. To overcome this adverse price differential the Board has had to seek alternative raw materials and methods of gas making.

For many years the industry has been supplementing the carbonisation of coal by enriching water gas by oil gas and in recent years North Thames has been testing several new methods of gas making, such as converting oil to gas by catalytic methods, and complete gasification of small coal. It has now started to use refinery gases for making towns gas. Apart from providing additional raw material the use of refinery gas has special advantages in that the capital required is appreciably less than for orthodox gas making plant, fewer workers are needed and operational costs are reduced. Therefore, by arrangement with the Shell Petroleum Company, Ltd., the Board agreed to take 25,000,000 therms a year, equal to about 14,000,000 cubic feet of gas a day, for a period of 10 years beginning in mid 1958. This amount is equivalent to the gas produced from 250,000 tons of carbonisation coals per annum and is approximately 6 per cent of the Board's total production.

The development of the new source of supply was in three parts: a preliminary purification unit, at Shellhaven, for the removal of hydrogen sulphide and organic sulphur; a pipeline; and a reforming plant at Romford. Last week we were able to pay a visit to Romford to inspect progress of the reforming and other units and to see a film which showed the various stages in the laying of the pipeline, and illustrated the difficulties overcome and the operation of the mechanical plant.

The gases are a by-product of the refinery processes and result from the breaking down of crude oil into its various fractions. At present these by-product gases are used largely by the refinery for providing process heat. The gases appear at the lower end of the hydrocarbon scale and have an average calorific value of 1500 B.Th.U. per cubic foot. In this form the gas is not suitable for admixture with town's gas, where the calorific value is rigidly controlled at 500 B.Th.U. per cubic foot, and it would not be possible to use the gas in existing appliances. It is necessary, therefore, to convert these rich gases down to a calorific value of 500 B.Th.U. and to the same combustion characteristics as town's gas. This conversion could be carried out at the refinery, but Shellhaven is distant from the Board's main distribution lines so that a main had to be laid from the refinery to the heart of the existing system. Distribution costs are primarily dependent upon the calorific value of the gas (the higher the calorific value the lower the costs) and therefore influenced the decision to carry the rich gases from Shellhaven to a nodal point in the distribution system at Romford.

At the refinery the gases are at a pressure of 160 lb per square inch and, in the first stage, pass through the Girbitol process where most of the hydrogen sulphide and some of the organic sulphur is removed by washing in an organic solvent. In the second stage, alkalis are used to remove more of the hydrogen sulphide and some organic compounds and finally, in the third stage, the gases are dried by passing through vessels containing alumina, which absorbs the water. They pass through metering and quality controls before leaving at a pressure of 120 lb per square inch. The next stage is the pipeline itself and between April and October of last year, 15¼ miles of 24in diameter steel main were laid through the Essex countryside between Shellhaven and Romford. This was a major operation and the pipeline was contour-laid with no facilities for the removal of liquids other than by passage of a "pig." Each section was "pigged" as constructed with an isotope loaded "pig" being used for final proving. Several complications and obstacles had to be overcome *en route*, including :—swamps, ponds, running sands, large and small water courses, ballast pits, railways and roads.

It was necessary to provide for the possibility of increased supplies of gas coming from Shellhaven, Coryton and Canvey Island and

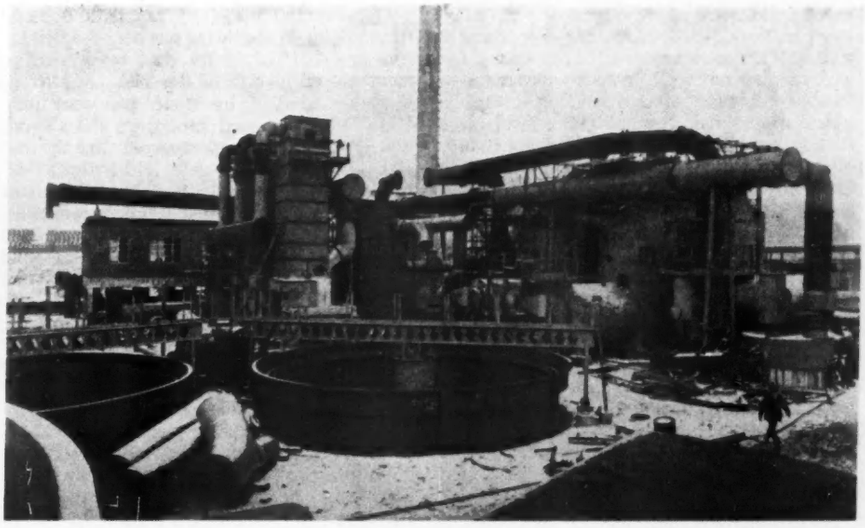
Ditch cutting machine in operation

since the cheapest method of allowing for this is to provide a main in which the pressure can be increased to a high degree, a steel main was chosen. This implies, in this part of the country, the need to adopt rigid precautions for external protection, and another essential was that the gas should be free from sulphuretted hydrogen and water in order to obviate internal corrosion, thus requiring purification at the refinery. A resistivity survey indicated that over the route the soil was very corrosive, 200 ohms per cubic centimetre being recorded over about half of the route length. A current drainage test indicated that 200mA per mile would give full cathodic protection and the protection arrangements consist of a transformer, rectifier and graphite ground bed installation designed to give a twenty-five years' life.

A "Traxcavator" removed a 40ft wide track of topsoil to a depth of 1ft and was followed by a Cleveland ditcher, illustrated herewith, which excavated a trench 40in wide to a depth of 5ft or more at a rate of 15ft per minute. The 26ft lengths of pipe were strung out along the line of trench, welded on site, joints tested and protected, and lowered into the trench by side boom tractors as illustrated above. This latter operation was carried out in the later stages with the help of rolling pipe cradles, having rubber wheels, which device helped to make the "snaking in" of the pipe-string a fast operation. Power rammers and calf-dozers filled up the trenches and replaced the top soil.

The 24in o.d. steel pipe has a wall thickness of $\frac{5}{16}$in and was supplied in 26ft lengths with an internal coating of red lead and an external protective covering of filled blown bitumen into which woven glass was drawn. Joints after welding were covered with P.V.C. tape coated with a pressure adhesive and protected by a round of roofing felt. Cold bends up to 5 deg. were made in the pipes, while firebends were made for bends of 45 deg. and 22½ deg. The arc butt welded joints were tested by ultrasonic means and the exterior covering of the pipeline was checked by a holiday detector set: any small holidays discovered in the protective coating were sealed by melting in bitumen, while larger ones were repaired by trowelling in the supplier's material. The designed maximum working pressure in the pipes is 275 lb per square inch and the hydraulic test pressure is 400 lb per square inch. It is of interest to note that the pipeline, at maximum working pressure, will hold 5,000,000 cubic feet of gas, the equivalent of a storage holder, thus obviating the need to erect one. The calorific value of the gases will, depending upon the refinery process, range between 1000 and 2000 B.Th.U., but will be generally about 1500 B.Th.U., the principal constituents being hydrogen, ethane, propane, butane, ethylene and propylene. Initially, the pipeline, which has a potential of approximately 10,000,000 cubic feet per hour, will carry a load of 4,000,000 cubic feet of rich gas per day. The work was carried out by William Press and Son, Ltd., and this summer it is proposed to extend the line to Coryton refinery and to methane storage tanks at Canvey Island.

The third part of the development concerned the Board's Romford works, at which the gases arrive at a pressure between 20 lb and 100 lb per square inch and where it will be reduced to 7 lb per square inch. This refinery gas, free from sulphuretted hydrogen and water, with a calorific value of 1500 B.Th.U., has to be transformed to gas of 500 B.Th.U. At Romford, the plant to do this will be operated on the Onia-Gegi principle, a French process of which the manufacturing rights are held in this country by Humphreys and Glasgow, Ltd., and this firm at present is engaged in erecting the plant, of which we reproduce a general view. The principle involved includes the passage of a portion of the gas over a nickel catalyst with steam to convert the higher hydro-carbons into a mixture mainly of hydrogen, carbon monoxide and carbon dioxide, producing a gas with a calorific value of about 320 B.Th.U. per cubic foot. This gas is admixed cold with the remainder of the gas coming up the pipeline to give a material of 500 B.Th.U. precisely and with the same combustion characteristics as town's gas derived from the traditional raw materials. The plant consists of four catalyst vessels, estimated to produce 36,000,000 cubic feet per day of 500 B.Th.U. gas. Part of this plant is adapted to use primary flash distillate or light spirit as a raw material in the event of a failure in the supply of refinery gas. Future extensions in the acceptance of refinery gas have been catered for in the design of the plant. The reformed gas will be delivered into the grid by a new pumping installation, and the output should be sufficient to supply all the area east of Romford, with something to spare for the area now mainly supplied by the Beckton works.



**Reforming plant under construction showing reactor and regenerator vessels, settling tanks and scrubbers**

The capital cost of the new works will amount to 1·0d. per therm compared with 2·9d. per therm for traditional plant. It will be equivalent to building a new works sufficient to supply a town with a population of 500,000, and the addition of tail gases from Coryton refinery and methane from Canvey Island will open up a greater prospect for the future. The whole scheme means increased production at lower costs than by traditional methods, and will help to keep prices stable.

# Mobile Materials-Handling Plant in a Steel Works

*Mobile engineering plant has long been used for materials handling in the Port Talbot works of the Steel Company of Wales. A new department was set up to co-ordinate this class of plant some three years ago, since when the plant has been adapted and modified in different forms for a wider range of duties. This has led to a high degree of flexibility and economy in bulk materials handling and storage and in other directions.*

DURING a recent visit to the Port Talbot works of the Steel Company of Wales we were able to see some of the interesting results of a mobile engineering equipment co-ordination scheme, and the ways in which specially modified orthodox civil engineering equipment has been adapted to meet the problems of raw materials handling and debris removal in furnace repair work. A study of these particular problems was initiated some three years ago when a new mobile and civil engineering plant department was set up. Its primary purpose was to co-ordinate the operation of all mobile plant already in use and to investigate the application of such plant in connection with large scale materials handling projects, on a works-wide basis. In addition to the investigation of such projects it was charged with the selection of appropriate machines and equipment and the subsequent control and co-ordination of their operation. The centralisation of the company's mobile and civil engineering equipment resources meant among other things that machines could be deployed on a works priority basis rather than a departmental one. The result was that a much higher utilisation was obtainable as, on completion of a job within one department, a machine could be promptly moved to another elsewhere in the works.

Early investigations and experiments showed that in the interests of speed and mobility on the works roads it was desirable to use pneumatic tyred machines, such as cranes, scrapers, shovels and bulldozers, whenever possible rather than crawler track machines which were less mobile. A complete study was made of various kinds of equipment: after purchase of the most suitable make for a particular class of work

modifications were introduced in practically every class of plant, to enable it to comply with the arduous duties in steel works for which it had not been primarily designed.

An application of civil enginering mobile plant which has resulted in considerable savings has been in the stocking and recovery of bulk materials such as coal and coke. Generally stockyards with fixed plant installations for the distribution and recovery of materials are limited to their designed capacity and cannot readily be extended. Further, when main works expansion or re-planning is necessary they can entail heavy demolition and reconstruction work in their re-siting. At the Port Talbot works the problem of coal handling and stocking became critical when, as a result of expansions in coke ovens plant, the daily consumption of coal rose to over 5000 tons. It became necessary to hold a buffer coal stock of between 80,000 and 100,000 tons and the problem was complicated by the necessity of keeping separate stockpiles for the various grades required for blending.

It was eventually decided that a stocking system using pneumatic tyred scrapers would meet all the requirements as such machines could both pick up and put down coal, make their own stockpiles, move rapidly over a widely spread-out stockyard, carry loads without spilling (thus preventing contamination) and compact the coal without crushing.

A further point in favour of using scrapers was that they were of relatively low capital cost, inexpensive in material and operating manpower, and could readily be diverted to other work as required.

For this work of stockpiling and recovery the possibilities of a number of machines were investigated, and eventually two Euclid "S.7" 7-cubic-yard capacity over-hung scrapers were acquired and modified to suit the working conditions. These machines have since also been used with success in handling other more difficult materials such as limestone and fine and rubble ores. Another machine which has also proved valuable in grading and loading duties in the raw materials stockyards is the Michigan "175A" shovel. It has also worked well in combination with the Euclid scrapers working both as a pusher and as a loader for material brought from the stockpiles by the scraper. Additional tonnage required in the coal stockyards to meet the demands of the new coke ovens is to be handled by these two machines. Under the proposed procedure the shovels will first lift and load the coal directly into rail wagons from specially laid fringe stockpiles. When these piles have been exhausted and the length of travel is uneconomic for the shovels the remainder of the coal from the particular sector will be lifted and carried by scrapers to the rail track where it will then be loaded by the shovels.

With the mobile equipment now in use fixed stocking installations are no longer considered necessary and the stocks can be located at any convenient open site. An example of the value of this stocking procedure in emergency was given recently when, owing to an accident in the rolling mill, some 1500 tons of coke produced each day by the coke ovens could not be used in the blast-furnaces. Two stockyard sites were opened immediately on conveniently situated unused land, and with a shuttle service of six dump trucks the coke was transferred to the stockyards, where it was deposited to the required height using mobile 60ft-boom Crone and Taylor (Engineering), Ltd., stackers.

A further interesting development in the use of civil engineering mobile plant in the works is the application of the "Eimco" shovels, normally used in tunnelling work, and "Gradall" excavators for the demolition of open-hearth furnaces and the removal of debris and slag from the slag pockets during repairs. The use of this equipment has resulted in substantial savings in demolition costs and has speeded the work without undue interference to normal operation in other parts of the melting shop. At the Abbey works slag accumulates to a height of 8ft to 12ft in the slag pockets and when fragmented it is now being removed by "Eimco" shovels. These shovels are normally designed to dig up to a height of 5ft and have been specially modified to dig to the increased heights and load into dump trucks. They have also been reinforced to stand up to the heavier duties of slag handling.

**Dumper removing slag and debris from furnace slag pocket in melting shop at Port Talbot**

Under a practice developed as a result of experience in the melting shops at the Abbey works, two shovels are used, one in each of the two slag pockets of a furnace, simultaneously, and a small bulldozer is employed to keep the area reasonably clear of fallen hot debris. A team of five machine operators is used to work in spells between the three machines to ensure continuity and reduce exhaustion, as the whole operation is carried out in heavy dust, heat and steam. The debris material is loaded direct into heavy duty Foden dumpers which can be readily manœuvred through the casting bay to the slag pockets as required. This use of dumpers eliminates the need for using rail trucks to remove the debris, and avoids interference with normal melting shop rail transport by having standing wagons on the track during the loading operation.

At the Margam and Port Talbot melting shops of the company, the use of "Eimco" shovels is restricted due to obstructions in the front of the slag pockets. In addition, the type of charger used is not suitable for the demolition of furnace brickwork, and for this work there was introduced a "Gradall" excavator. This machine, designed originally for earth-moving and ditching equipment, is a self-propelled tracked vehicle on which is mounted a long telescopic arm which can be extended or retracted, slewed or rotated, and it can use various tools at the end of the arm; it was described on page 344, September 2, 1955.

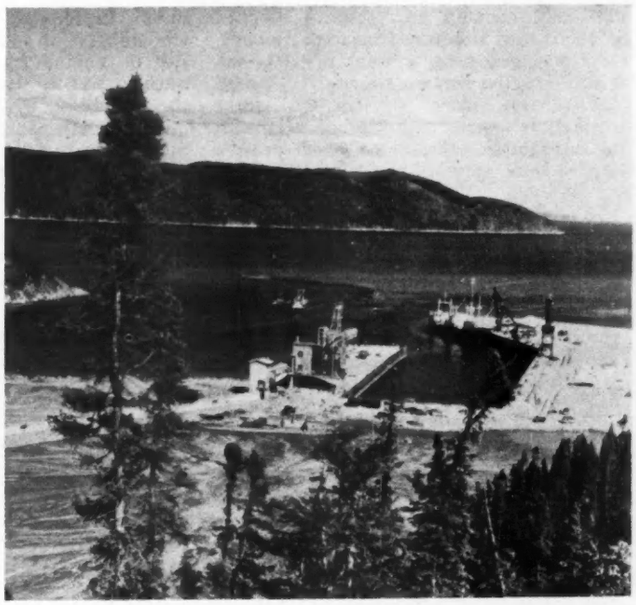
Under the procedure adopted, the "Gradall" is first used to rip down the furnace brickwork up on the stage level and then rake out the debris either down the uptakes or out on to a stage where small shovels take it to disposal chutes. The machine is then transferred down to the casting bay, where the slag in the pockets has already been fragmented by blasting. It is then used to dislodge and rake out the slag and debris on to the floor for loading into Foden heavy-duty dumpers by a "Caterpillar 977" shovel, as shown in the accompanying illustration. Whilst the "Gradall" is raking out one pocket, the shovel loads the material it has drawn out of the adjoining pocket of the furnace. To suit the excavator for this particular class of work it was extensively modified and reinforced, a metallic form of hydraulic piping fitted and special tools developed for handling the material.

For general maintenance, engineering and construction work six Jones "10–10" lorry-mounted cranes have been introduced by the new department and modified to suit special requirements in steel works use. Two Neals 12-ton mobile cranes fitted with special 45ft jibs are used for magnet and grabbing work in different parts of the works as required to supplement permanent plant. These cranes are also fitted with a special device which restricts loads to within the specified maximum, as in a general scrapyard it is easy for the magnet to become fixed or jammed in the scrap pile. Further modifications were also made to enable the cranes to stand up to arduous duties on a 168-hours week, as distinct from the normal construction work for which they were initially designed.

To ensure efficient maintenance and repair a large plant and vehicle workshop has been built and equipped to serve the mobile and civil engineering plant department. This section of the organisation has laid down comprehensive preventive and corrective maintenance schedules to cover all vehicles, and is closely concerned with the development and introduction of equipment modifications to suit steel works duties.

# Aluminium Smelter Plant at Baie Comeau, Canada

*The first stage in the construction of an aluminium smelter plant at Baie Comeau, Canada has been completed and work has begun on the second stage. Each stage has two furnace bays and when the third and fourth stages are completed the plant will have an annual capacity of* 160,000 *tons of aluminium ingot. In the photograph reproduced on the right can be seen the wharf, which can berth three* 10,000*-ton ships, with its unloading equipment and raw materials conveyor.*



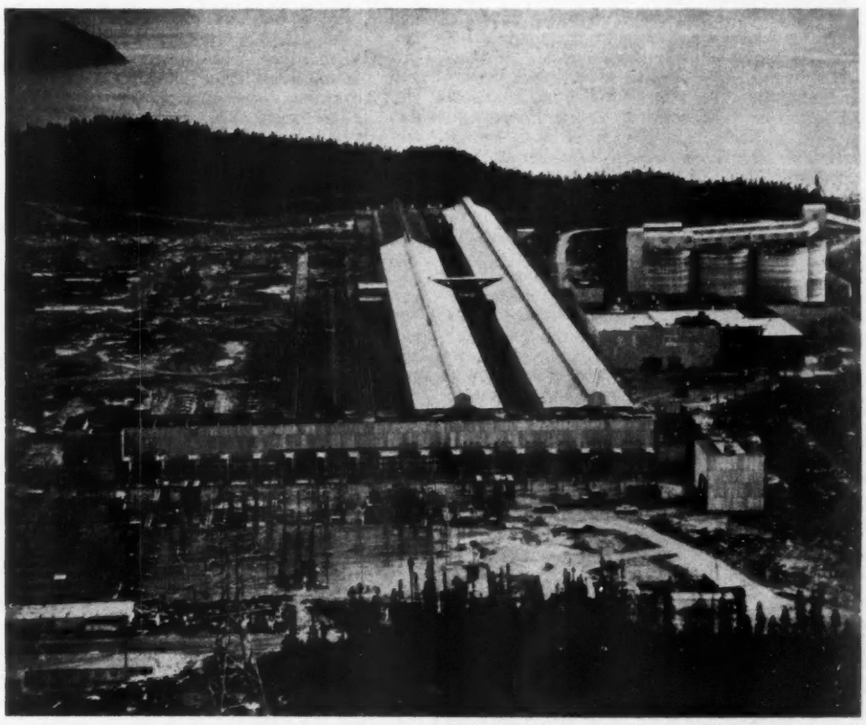
ONE of Britain's more important recent investments in Canada is the Canadian British Aluminium Company, Ltd., which is a subsidiary of the British Aluminium Company, Ltd., and was formed in partnership with the Quebec North Shore Paper Company for the purpose of producing aluminium ingot. Planning of the new smelting plant began in the winter of 1955 and levelling of the site commenced as soon as the weather permitted in 1956. Since then rapid progress has been made and on December 23, 1957, in less than twenty months after site clearing was started, the first metal was poured. This event marked the completion of the first of four production stages of the new plant which when complete, will have an annual capacity of 160,000 tons of virgin aluminium ingot, a total which represents two-thirds of the present annual consumption in the United Kingdom.

The smelter is located at Baie Comeau which is in the Province of Quebec and on the north shore of the lower St. Lawrence River some 400 miles north-east of Montreal. A wharf capable of berthing three 10,000-ton ships, and illustrated above, has been constructed and the ship-borne raw materials such as petroleum, coke, and alumina, are handled by a pneumatic unloading plant and carried from the dock to the smelter by a belt conveyor system about 3000ft in length. The first stage of smelter plant, recently completed, has a capacity of 40,000 long tons a year and, in common with the three stages yet to be built, has two furnace bays each about one-third of a mile in length. A housing estate has been built to accommodate personnel. Present requirements for power are met by the Maniconagan Power Company, which has extended the McCormick Dam and has installed three 50,000 h.p. generators to raise the capacity of the generating station to 250,000 h.p. Work is already well advanced on the second stage of the smelter and, when completed by the spring of next year, it will raise the production capacity to 80,000 tons of virgin aluminium a year.

### Smelter Plant

The two furnace rooms are more than 1700ft long and have a rectifier house at one end and a casting shop at the other, and each has a total of 84 vertical stub pattern Soderberg furnaces connected in series. Also forming part of the plant there are a carbon factory, a laboratory, a service building, workshop and offices, together with alumina and coke silos. These provide a substantial amount of storage space, sufficient to keep the plant supplied for the period of about four months during which the St. Lawrence is closed to navigation. The general arrangement of the plant is seen in the illustration below, which shows the silos behind the service building and three furnace bays with rectifier house in front. The belt conveyor, which links the three 550ft ship unloading berths with the silos, is at present handling 125 tons of coke and alumina an hour, but this is well below the maximum designed capacity which is 400 tons per hour.

Power for stage one, amounting to 120,000 h.p. and part of stage two is being supplied by the Maniconagan Power Company, which, as already mentioned, has installed new generators to meet the load. To provide a regulated water supply throughout the year a large storage dam is being built at Lake St. Anne up the Maniconagan River. Power is transmitted over the 11 miles from the generating station to the outdoor switchyard of the Canadian British Aluminium Company, Ltd., at 161kV. Here it is handled by air-blast switchgear and 115MVA transformers, manufactured by the English Electric Company, Ltd., transforming down to 33kV for the rectifying equipment for the furnace rooms and to 13·2kV for the works distribution supply. Each furnace room has rectifying equipment consisting of eight rectifier banks each having eighteen individual pumpless



**Smelter plant at Baie Comeau showing smelter bays under construction and raw material silos to the right**

steel tank mercury arc rectifiers supplied by The British Thomson-Houston Company, Ltd., and delivering a total of 100,000A at 850V to the furnace rooms. A 13,200V 15MVA ring main supplies the works distribution system and interconnects with five distribution sub-stations which provide the 550/110V supplies for auxiliary power and lighting.

To produce a ton of aluminium the process uses about half a ton of carbon, and to provide the necessary supplies a carbon factory has been built to form an integral part of the smelter plant. The factory, which is highly mechanised, has two main products, namely, carbon paste for the anodes of the furnaces and carbon mixture for the furnace linings. The raw material, calcined coke, is stored in two 6000-ton silos, dried in an oil-fired rotary drier and then screened to separate the various size fractions ranging from ¼in to dust. To produce the required quantities of the finer grades, coarser materials are reduced in roll crushers and afterwards passed through an air swept ball mill. Predetermined quantities of each size fraction of coke are then blended and fed to continuous mixers where molten pitch is added. Heating of this section of the process is by hydrotherm fluid. The mixture emerges as a paste in strips and is cut into briquettes which are cooled and then stored ready for feeding to the anodes of the reduction furnaces. The grist for the preparation of the furnace lining mixture consists of calcined anthracite, using pitch softened by creosote as a binder, and the mixture is produced in batch mixers.

MAIN SUPPLIERS

The British Thomson-Houston Company, Ltd., rectifying equipment; The English Electric Company, Ltd., transformers; Redpath, Brown and Co., Ltd., structural steel; The Cement Marketing Company, Ltd., cement; Steel Company of Canada Ltd., cathode bars and anode stubs; Dominion Steel and Coal Company, Ltd., reinforcing steel; Herbert Morris and Co., Ltd., Babcock and Wilcox Ltd., International Equipment Company, Ltd., Irving Cranes, Ltd., Charpente and Levage, cranes; W. and T. Avery (Canada), Ltd., scales; Maschinenfabrik Hartmann, pneumatic unloader and conveyor; Polysius Ltd., equipment for moving alumina from silos; Canadian General Electric, switchgear; Sir William Arrol and Co., Ltd., furnace steelwork; British Insulated Callender's Cables, Ltd., power cables; Chloride Batteries Ltd., batteries; The Yale and Towne Manufacturing Company, internal transport; Stein and Atkinson, Ltd., furnaces (casting shop); Baker Perkins, Ltd., mixer plant; Glenfield and Kennedy, Ltd., casting machine.

# Searching for Minerals in Australia

THE depletion of known ore reserves with the growth of the world's production of metals, has necessitated in recent years a marked increase in mineral exploration throughout the world. This applies especially to Australia, where many mining and exploration companies are active. One of the largest Australian exploration programmes is being undertaken by The Broken Hill Proprietary Company, Ltd. Many overseas steel makers are able to purchase their raw materials from independent producers, but the B.H.P. Company, Ltd., is responsible for the production of practically all its own requirements. With the rapid expansion of the industry, it has become essential to extend the development of the company's known mineral deposits, and at the same time to seek additional occurrences of the various raw materials required. The present rate of consumption of iron ore in Australia is about 4,000,000 tons per annum; the steel industry also uses about 3,250,000 tons of coal per annum, and other minerals, such as limestone, dolomite and magnesite, are also required in large quantities. Furthermore over twenty-five other minerals are needed in lesser quantities at the steel works. There are two main avenues of attack in modern mineral exploration. The areas near known orebodies are likely places in which to find extensions, and exploratory diamond or percussion drilling is carried out in such places. Secondly, mobile exploration parties must move throughout all parts of the continent in search of rocks in which orebodies may occur. In both methods of search the compilation of geological maps is first necessary. If areas near known orebodies are being studied the maps prepared are extremely detailed and may take many years of intensive field work and subsequent microscopic study in the laboratory of the rocks found. On the other hand, in dealing with large areas of Australia the geological maps are prepared in much less detail, as the areas covered amount to tens of thousands of square miles. For example, in the past five years B.H.P. geologists have carried out reconnaissance mapping over a total area in Australia of about 360,000 square miles, which is about the combined size of the British Isles, Germany and Italy.

The first stage in these reconnaissance techniques is that of aerial photography. The area surveyed will contain rocks of many different kinds, and specially trained geologists can recognise differences between the rocks showing in the photographs, by study through a stereoscope. Sometimes it is not possible to determine the precise rock type from such a study, but it is often possible to recognise a belt of rock, which may extend for many miles, as being composed throughout of the same rock. All such information is plotted on the mosaic to form a preliminary map, on which only some rocks can be named. This phase of the work is known as "photo-interpretation." Field work is next necessary, during which traverses are made so as to intersect as many of the rock types as possible. As soon as one belt is encountered, the rock type is determined, and hence the rock type of the whole of that belt of rocks, as shown on the mosaic, is known. Knowing the rock types which are likely to contain the minerals sought, it is possible to narrow the next stage of the search to relatively small areas. Then comes a detailed ground geological survey of these areas, usually in conjunction with ground geophysical survey. Once again the favourable areas are selected, but by now they are quite small, perhaps less than one square mile, and so can be further investigated by diamond drilling in the hope of intersecting a concealed orebody below ground level. Organisation of a modern prospecting party is complex in comparison with the old days of a prospector equipped with a panning dish, pick and shovel, salt beef, flour, tea and sugar. The minimum party to-day consists of a geologist and assistant who travel in a "Land Rover." The vehicle is usually equipped with numerous additions to cope with the remote locations met and rough terrain to be covered, for most of the time the vehicles are moving "cross country" far from any roads or tracks. This special equipment includes water tanks and extra petrol tanks, sandfly proof tents, a power winch for getting out of bogs, a deep freeze unit to keep fresh meat and provide cool tinned stuffs and water, and a portable radio telephone by which telegrams can be received and sent daily and which also provides contact between the party and the Flying Doctor base in event of emergency.

Parties range in size from the minimum two-man party to groups of over twenty men. Such large parties are only used when one particular mineral deposit or group of deposits is being investigated. Under these circumstances a base camp is set up from which operations can be directed and carried out. An example of a large party is the unit which is at present operating at Constance Range, in north-west Queensland, about 100 miles south of the Gulf of Carpentaria. At maximum strength this party comprised a total of twenty men, including the leader, a geologist, diamond drillers, bulldozer and motor truck drivers, mechanics, cooks and labourers. A large mess room has been built and equipped with stores and refrigerator. Marquee and ordinary tents have been provided for sleeping quarters, although many men prefer to sleep under the sky. Hot and cold showers have been set up. An electric generating set gives power for charging batteries for the vehicles and supplying light to all buildings and tents. A garden has been planted to provide fresh vegetables for the men, and beef is obtained from a nearby cattle station. Weekly trips are made by truck to Camooweal (130 miles distant), on the fringe of the Barkly Tableland, to meet the Trans-Australia Airlines plane which runs the out-back service in that area. Urgent replacement parts for drills, vehicles and machinery and other necessities can thus be obtained regularly and quickly. Work like that undertaken at Constance Range involves considerable office work and preparation of plans, and provision was therefore made of a specially equipped caravan, connected with the lighting system. The upper halves of the walls of the caravan were designed to fold down outside the vehicle to expose fly-lined openings and so take advantage of any breeze, for the climate is usually hot in latitudes so far north. The caravan was fitted with a desk, chairs, drafting desk, filing shelves and drawers, electric fan, and a small chemical laboratory, which required a supply of bottled gas to operate the heating apparatus and also connection to the piped water supply. The camp is equipped with a two-way radio, and with this it is quite possible, for example, to send a telegram to head office in Melbourne and have a reply back the same day. The mobile equipment comprises three 5-ton trucks, three "Land Rovers" and a bulldozer. The latter was used in forming rough access roads and in a few months about 200 miles of such roads have been made. One of the main objects of all this organisation is to test some low grade iron ore occurrences by diamond drilling, and it is largely to allow the drills to be moved, and to permit cartage of water to them, that the extensive network of roads had to be made. Three drilling rigs are being used, and by the end of the field season when the rains start, 4000ft to 5000ft of drilling will have been completed.

SPECIALISED TECHNIQUES

It will be realised that aerial survey looms large in any modern prospecting venture. There are, however, various specialised techniques for use by ground parties, which range from the now well-known Geiger counter, for uranium prospecting, to methods quite unfamiliar to the layman, such as the various forms of geochemical prospecting. During the field season of the current year, the B.H.P. group has over forty men in the field engaged in mineral exploration (excluding drillers), of whom about eight are geologists and a further four or five are trained prospecting assistants. So far as exploration in northern Australia is concerned—which includes the greater part of B.H.P. field activity, other than in the vicinity of operating deposits—heavy rains preclude field work for one to two months prior to and three months after the New Year. During this time the technical field men return to head office, where they prepare reports on their recent field work, together with rough plans ready for final drafting. Later, they carry out interpretation of aerial photographs and general preparation for the ensuing field season. Emphasis has been laid on B.H.P's prospecting activities in northern Australia because exploration forms a large proportion of the work of the company. However, activities are by no means confined to this area, for a survey of iron ore in New South Wales is now under way, and in the same State drilling for beach sands is in progress, while in Tasmania a search is being made for tin. A search for iron ore has also been made in southern Tasmania, using a helicopter. Geological parties have made surveys in Malaya, the Philippines, New Zealand, New Guinea, New Britain, New Caledonia and Fiji. Company geologists keep abreast of world developments in mineral exploration, and a number have made overseas visits for this purpose. Geology is a fascinating profession. Certainly no other calling offers such opportunity to see Australia's lesser known parts at close quarters, and in the process enjoy an outdoor life.

# SHORTER REPORTS

## Road Schemes

DURING the past few days information has been received from the Ministry of Transport and Civil Aviation about a number of important road improvement schemes. The Hertfordshire County Council has been authorised to accept the tender of Tarmac Civil Engineering, Ltd., for the construction of the first section of the St. Albans by-pass, which forms an essential part of the London–Yorkshire motorway. This section, to cost about £4,500,000, extends from the North Orbital Road near Park Street to the boundary of the Hertfordshire and Bedfordshire counties, and includes a link with the A6 route just south of Lincoln. The contract date for completion is October 31, 1959, the same as for the Birmingham section of the motorway.

The St. Albans by-pass will connect with the Birmingham section of the motorway at Pepperstock near Luton. From this point a connection provided with route A.6 south of Luton will enable the by-pass to be used by drivers wishing only to avoid going through St. Albans itself. The by-pass will be in the shape of an inverted Y. On the stem there will be dual 36ft carriageways, while the two arms will have 24ft carriageways. To ensure an uninterrupted flow of traffic, fly-over junctions will be provided at the junction of the Luton link and at Beech Tree where the road divides. A two-level junction will also be formed at the point where the new road will be joined by a spur to the newly-industrialised parts of Hemel Hempstead. There will also be connecting links where the new road passes the A.5, west of Harpenden.

Tenders have been invited by the Ministry for the building of an underpass on Western Avenue at its junction with Hangar Lane in Middlesex. This underpass, to cost some £650,000, will have dual 24ft carriageways with additional 24ft carriageways branching from both sides to form a surface connection with the North Circular road for turning traffic. It forms part of a comprehensive scheme for the modernisation of Western Avenue and a new stretch of dual carriageway from Park Royal Station through the underpass to Alperton Lane, costing about £300,000, will link up with adjoining lengths to the east and to the west which are now open to traffic. When this last section is completed, the dual carriageways will extend for over 10 miles.

The Oxford City Council has placed a contract for the second section of the Oxford Eastern by-pass with John Laing and Son, Ltd. Work on this section is expected to start in March next and be completed by the end of this year. An improvement scheme on the Glasgow–Stirling road, which will cost about £435,000, has been authorised by the Secretary of State for Scotland. This work, to be carried out by John Wright and Co. (Edinburgh), Ltd., consists of the widening and re-alignment of over 3 miles of the trunk road between the Dumbarton–Lanark County boundary and the town of Cumbernauld, and includes a diversion of just over a mile in length at Condorrat.

## Training Technicians

LAST Friday, Mr. A. A. Part, an Under-Secretary of the Ministry of Education, spoke at a residential course for teachers in schools and technical colleges which was held at St. Annes-on-Sea. He stated that the Minister of Education had asked the Central Advisory Council for Education to conduct a special inquiry into the wastage of students in some of the main part-time courses in technical colleges. Mr. Part referred to figures recently quoted, notably by Professor Lady Williams* in her book *Recruitment to Skilled Trades*, and by Dr. Frisby, of the National Institute of Industrial Psychology, which suggested that far too many students failed to complete their part-time courses and that some radical changes ought to be made in the present arrangements.

Mr. Part went on to say that Dr. Frisby had taken a sample of 1862 engineering craft apprentices. After leaving aside 155 who had got nowhere in any kind of course, 1180 were entered for National Certificate courses and 527 for City and Guilds courses. According to Dr. Frisby's summary of the results, 63 per cent of the 1707 did not achieve the level of the Ordinary National Certificate or the final City and Guilds. About that analysis, Mr. Part said it would have to be a very unusual group of craft apprentices to justify so high a proportion as two-thirds taking National Certificate courses rather than City and Guilds courses. Furthermore, it was the intermediate rather than the final level of the City and Guilds course which the average craft apprentice of to-day might be expected to reach, and, Mr. Part remarked, he should become a quite decent craftsman by doing so provided that his practical training in industry had been satisfactory.

There were two remedies, Mr. Part went on to say, which could be seen to be desirable. First, there was the need to provide more practical courses like the new course in mechanical engineering craft practice. Secondly, there was a need to re-emphasise the relatively high standard of the National Certificate to make clear that, even in its first three years up to Ordinary National Certificate, it was designed for future technicians and technologists and was suitable only for those craft apprentices who had an academic background that was above average and who showed strong promise of being able to rise out of the ranks of craftsmen. Although there was some wastage in Higher National Certificate courses and rather more in the later stages of the Ordinary National Certificate, Mr. Part added, the really substantial wastage occurred right at the beginning of the course. From the evidence available, it seemed that very few of those who failed the examination at the end of the first year of the course ever ultimately obtained an O.N.C. All this strongly suggested that there was something wrong with the arrangements for admission to National Certificate courses. Too many students, Mr. Part thought, were being admitted either with inadequate ability in mathematics or with too narrow an academic background or, more probably, both.

* An article by Lady Williams is concluded on page 198.

## Studying the Economics of Transport

DURING the past two years the Institute of Transport has sponsored a project to establish at the University of Oxford a readership and research fellowships in the economics and organisation of transport. A substantial sum of money was required to initiate the project and a sufficient sum was promised by associations and individual undertakings in or connected with the transport industry, and by users of transport, to enable the Institute to make a formal offer to the University; the Institute has completed a covenant to transfer the donations to the University over the next ten years. The scheme in its final form will cover not only a readership, but also the establishment of research fellowships—it is hoped at least two—in the colleges; provision is also made for the making of grants to other members of the University to encourage and advance the study of the economics and organisation of transport.

The project was conceived by the Institute of Transport in the belief that the time was long overdue in this country when the many problems of transport economics and organisation should receive much greater recognition than hitherto as subjects for University research and teaching in this country. The view was taken by those who initiated and sponsored the project that if a readership in transport, supported by research fellowships, could be established, great benefits would eventually accrue, not only in the gradual building up of an authoritative body of knowledge and opinion on the complex problems of transport, which would give a surer foundation to Government and commercial policy than had existed in the past, but also in more and better teaching of the subject which would appeal to able young men who might thus be attracted to transport as a career. The hope is that the first appointments to the readership and fellowships will be made with effect from next October.

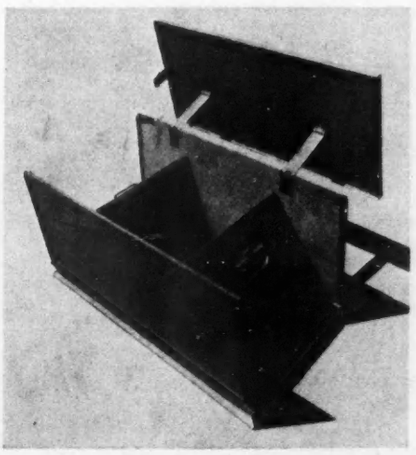
## Institution of Mechanical Engineers

THE Institution of Mechanical Engineers says that the third annual Leonardo da Vinci lecture for boys and girls from public and grammar schools will be delivered on Tuesday, April 1, at 10 a.m. and again at 2.45 p.m. The lecture, which is suitable for boys and girls of fifteen and upwards, is entitled "Rockets and Guided Flight"; it will be given by Mr. A. D. Baxter, Mr. L. H. Bedford and Dr. G. W. H. Gardner. The lecture will be delivered at the Institution's building, 1, Birdcage Walk, London, S.W.1, the morning session being for those from schools in London. The afternoon session is intended mainly for those who reside or attend schools outside the London area. Whilst the bulk of the admission tickets will be distributed to schools, a limited number will be available for individuals who should apply to the secretary of the Institution at the above address.

Another announcement from the Institution says that the council has decided to grant exemption from the Institution examination, under certain conditions, to holders of a Dip. Tech. (Eng.) gained after completion of a mechanical engineering course which has been approved by the National Council for Technological Awards. The conditions which have been laid down by the Institution's council concerning the matter are set out in the February issue of *The Chartered Mechanical Engineer*.

## Collapsible Container

AT a recent demonstration we saw the "Retemba" collapsible container which is being introduced in this country by Warwick Production Company, Ltd., Birmingham Road, Warwick. The container, which is being built under Swedish licence, has undergone extensive practical tests in Sweden, where, it is stated, it has



**Collapsible container in half-folded position. Made from 10mm plywood and a light-alloy frame, it can be collapsed to 17 per cent of its full height**

been found to withstand 100 railway journeys without requiring more than minor repairs. Its construction may be gathered from our illustration which shows it with the lid half-open and the two ends folding inwards. The panels are made of five-ply laminated timber, 10mm thick, specially bonded and treated to withstand rough usage and exposure to the weather. The frame is built from corrosion-resistant, heat-treated aluminium alloy extrusions, and the panels are fitted to it by riveting. In order to permit the full use of internal capacity, the interior of the erected container is free from obstruction, all fittings being recessed. Handles, clasps and hinges are of cadmium-plated steel, the clasps being of spring steel. At each end of the container is a clip-fastener which closes when the lid is placed in position, and is released by pushing a lever, which may be seen just above the carrying handle, as well as pulling a leather strap fastened to the clip. This lever has an upturned lug which passes through a slot in the fastening clip and is provided with a small hole for receiving a wired lead seal.

When the lid is raised it folds over on its extended double hinges, flat against the vertical side of the box. By pressing the flat springs near the inside top edges, the end panels are released and fold inwards, whereupon the other two sides and the lid can be folded down, giving a collapsed height of only 17 per cent of the full height of the box. The maker states that initially two sizes (30in by 15in by 15in internal and 30in by 22¼in by 15in internal) are to be produced. These weigh 29 lb and 37 lb, respectively. The largest container of this design so far has been an 8ft by 6ft by 4ft box built in Sweden.

## Fluorescent Lighting Fittings

OUR illustration shows some examples of a new range of fluorescent lighting fittings introduced by The General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2. The "101" range, as it is called, is based on a national survey of customer requirements and it consists of a wide variety of fittings for industrial, commercial and decorative use, each of which is designed to be easily assembled, without special tools, on to a single standard channel.

For this range a new channel of standard section has been designed in the usual sizes from 8ft to 1½ft. This basic channel is of steel with die cast ends; it is normally stove enamelled white but a "super" corrosion-resistant finish is available to order. The same channel is suitable for single or twin holders. Various methods of fixing the channel are catered for. First, there is a series of ¾in knockouts for use with either conduit suspensions, or hooks attached to chains. Two knock-outs are ready drilled and fitted with rubber plugs. A conduit entry, fitted with a white polythene plug, is provided at each end. Alternatively, the channel can be screwed direct to the ceiling by using cup washers which fit into any of the knockouts with a generous tolerance on centres. For installations where adjustable or non-standard centres are required the unit has a continuous rail arrangement which engages with sliding hangers which can be purchased separately.

G.E.C. control gear is used throughout the new range; switchless or switch circuits are available with 3ft, 4ft, 5ft and 8ft units, but the 1½ft and 2ft sizes are for switch circuit only. The control gear is locked on to the backplate, with which it is in full thermal contact. Internal wiring is secured by special insulated cleats and a G.E.C. fused mains terminal block is provided for incoming cables.

New tube holders have been designed for standardisation throughout the range. All "Osram" tubes up to 5ft in the range are fitted with bi-pin caps, the holder at one end being retractable, but the 8ft, 125W "guaranteed" tubes have the new R.D.C. (recessed double contact) caps. On these new caps the contacts are recessed into a central moulded spigot. Electrical connections are made by two spring-loaded plungers in each holder to engage with the cap contacts. The central spigot provides easy location when tubes are fitted into their holders, shields the contacts from mechanical damage and lessens the risk of electrical shock if tubes are inserted or withdrawn while the fitting is "live." With the R.D.C. cap and the retractable holder at each end, replacement of the 8ft tube can be done single-handed from one ladder position.

The "101" fittings available include a pressed steel reflector, a "Perspex" reflector, a metal louvre, open ended reflectors in steel or "Perspex" and a variety of diffuser fittings in glass or "Perspex." One, in particular, is glazed with a special sheet with pyramidical embossing to give considerable control of the downward light, the main angle of emission being within 50 deg. from the vertical. Above this viewing angle the glass appears faintly luminous.

The company has also introduced a new "101" under-access trunking system, specially designed for large industrial installations. It has the usual provision for cable runs and locked-in gear trays and the method of attaching reflectors is identical with that for the "101" range of lighting fittings. The new trunking can either be suspended from sliding hangers, or mounted direct to a ceiling. "101" range fittings can be attached in any position along G.E.C. cable trunking, which consists of 2in square ducts available as units with one, two or three compartments. The ducts can either be recessed into the ceiling, surface mounted or suspended. An alternative method consists of a single-way duct designed for suspension and fitted with 13A socket outlets. Integrated with the underside of the duct is a continuous rail from which "101" fittings can be suspended by means of sliding hooks. By wiring each fitting with a short T.R.S. tail terminating in a 13A fused plug, the whole unit can be erected or removed simply by hanging it on the rail and plugging it into a socket.

## 18,400kW Germanium Rectifier Installation

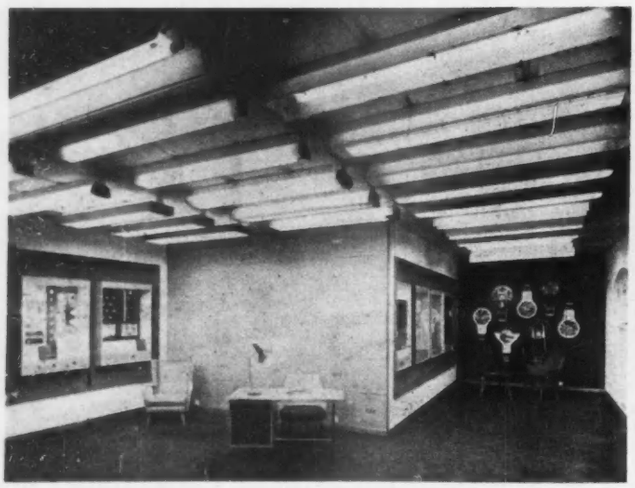
A GERMANIUM power rectifier rated at 18,400kW 80,000A, 230V has been installed by The British Thomson-Houston Company, Ltd., at the Ellesmere Port plant of the Associated Ethyl Company, Ltd. The rectifiers supply d.c. power to two electrolytic cell lines for the production of chlorine, and consist of two equipments each of four units, each unit being complete with its own transformer and associated switchgear.

The rectifiers are connected in a three-phase bridge circuit with phase-shift transformers to give forty-eight-phase overall operation. The output of each unit is controlled by means of an auto-connected regulating transformer equipped with seventeen-position on-load tap-changing gear and a trimming regulator to give fine control between tappings. The induction-type trimmer is excited from a tertiary winding of the regulating transformer and feeds back into a series boost transformer connected between the regulating and rectifier transformer primary winding. The regulating, series booster, and rectifier transformers are combined in one unit. The induction regulators are driven by selsyn receivers controlled from one master selsyn transmitter for each cell line. Current transformers are provided to measure the d.c. output from each unit for metering and constant current control. The summated metering signal is compared with a preset reference voltage, and the error signal is sent through an electronic amplifier to the amplidyne controlling the master selsyn transmitter. When the induction regulators reach the end of their travel, a transformer tap change is initiated and all four units are resynchronised to ensure that correct load sharing is maintained.

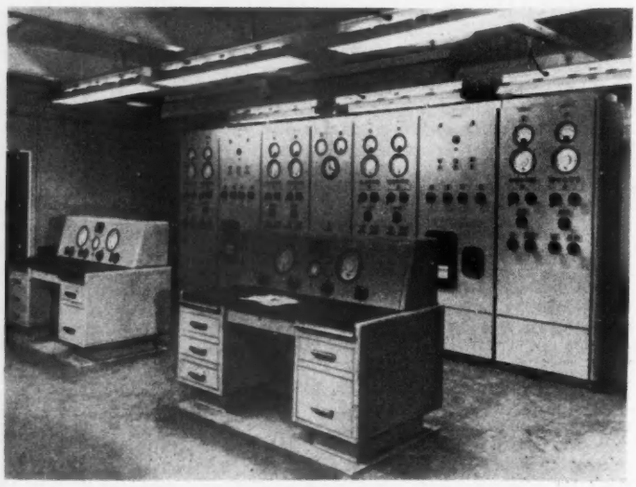
The rectifier unit is divided into three cubicles, each cubicle holding six trays of germanium cells which are connected in a series-parallel arrangement.

Both equipments are controlled from desks situated in a central control room, which also houses the metering, incoming and alarm panels. In the accompanying illustration of the control room, each alternate panel serves two two-rectifier units.

The loss in the rectifier cell is very small: almost all this loss occurs during forward conduction and corresponds to a voltage drop of 0·5V per cell. The overall efficiency of the rectifier, main and regulating transformers, trimmers and phase shifters at normal load exceeds 96 per cent.



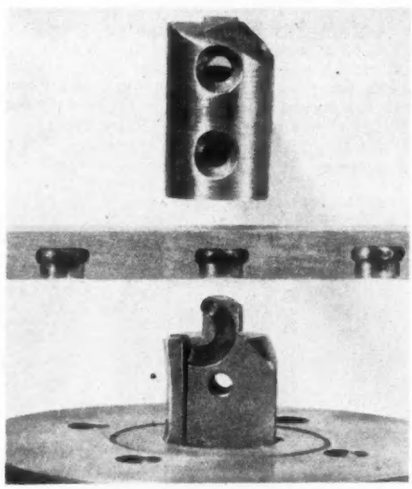
Display of "101" range of fluorescent lighting fittings



Control room of 18,400kW germanium rectifier installation at Ellesmere Port

## Intrinsically Sealed Rivets

THE use of integral fuel tanks on an aircraft demands a method of sealing that will be highly reliable for long periods of operation, since the tank will be primary structure and correspondingly exacting to repair. The sealing means must also be unaffected by definite and repeated distortions of the tank under load. A fundamental approach to the problem of fuel leaking from the inside to the outside of a wing was made some years ago by the English Electric Company, Ltd., and described by Mr. G. H. Taylor at the recent conference of the Institution of Production Engineers on Problems of Aircraft Production : the method was not adopted on the company's "P.1." aircraft, the sealing techniques on which were described to the conference in a paper, "Some Aspects of the Design,

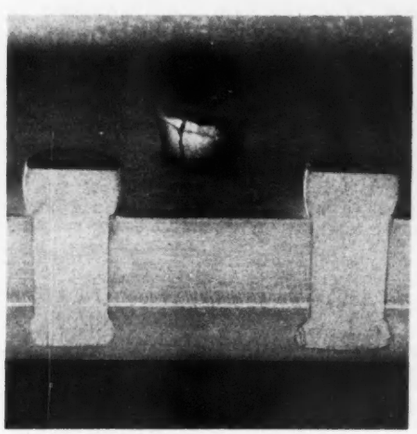


**Cutter for groove in hole partly dismantled**

Development and Manufacture of the P.1. Wing." One remarkable disclosure in this paper was that the joining of the left and right halves of the wing is a factory operation : this implies the existence of a spare part roughly 30ft long and 30ft wide.

The novel process employs what is called a cavity sealed rivet. The principle can be derived with ease from the accompanying illustration of a sectioned joint : a blind hole of reverse taper is made in a plate and a rivet expanded into it.

The technique employs several operations of no great complexity. First a hole is started at the correct rivet location : a flat bottoming cutter is then run into this hole to the correct depth. The circumferential groove round the bottom of the hole must then be made : this can be done either with a ball-ended cutter small enough to pass through the throat of the hole and given a planetary feed, or by a special cutter.



**Sectioned specimen joint, showing grooves for escape of air from blind hole**

The latter method can, it is believed, cut the groove as quickly as a through hole could be counter-sunk. The tool, driven by a conventional portable compressed air drill, has a "banana-shaped" cutter, illustrated, which is extended by screwing back a nut surrounding the body of the tool : the tool is made so that it cannot cut an oversize groove so long as the tool is pressed on to the flat bottom of the hole. The cavity is then inspected for the correct profile, and particularly for the absence of any chamfer or radius on the outer edge into which the rivet might expand.

The rivet and the attachment are then placed. In the development programme of the company "Duralumin" rivets to L.37 or L.1 were used, and it was found that $\frac{1}{16}$in rivets required a force of 5 tons to expand in the solution treated condition and 4 tons when aged, due probably to the greater friction of the softer metal in hole and shroud. Nevertheless, all rivets were closed within two hours of quenching, or kept refrigerated. To permit the escape of air from the hole three longitudinal grooves and two circumferential grooves were made on each rivet : symmetry was maintained to avoid the possibility of a rivet being reversed. The rivet is lubricated and surrounded by a shroud to limit deflection of the exposed shank : a punch is then inserted into the shroud and driven. This operation is scrutinised by inspection to ensure full expansion of the rivet into the cavity.

Finally, the stem is panned by conventional methods : since the rivet has been expanded tight into the hole in the attachment, closing up of the joint is already assured. This process was tried out with 0·2in skin and attachments up to $\frac{1}{4}$in deep, all of "Duralumin," and it proved to be a reasonable production proposition to prepare reliable panels.

## Small Hand Stacker Truck

WE illustrate below a hand-propelled stacking truck which has been developed for use in small establishments by Lansing-Bagnall, Ltd., Kingsclere Road, Basingstoke. This straddle design machine is capable of lifting loads of 1120 lb at 15in load centres to heights up to 7ft. It can be

**1120 lb capacity battery-operated, hand-propelled stacker truck**

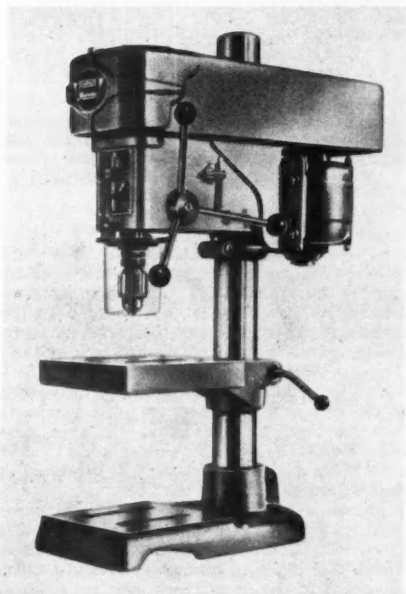
readily manœuvred in gangways less than 6ft wide.

Power for the truck is supplied by a 12V battery and its motor drives the high-pressure hydraulic pump of the lifting gear. Push-button control gear is fitted and the lifting speed is about 10ft per minute. A built-in charging gear is provided for the battery and can be plugged in directly to the mains supply.

## Sensitive Drilling Machine

A SENSITIVE drilling machine of $\frac{1}{2}$in capacity is now being made by the Startrite Engineering Company, Ltd., Gads Hill, Gillingham, Kent, in two models—a bench mounting model with a maximum distance of $13\frac{7}{8}$in between the chuck and table, and a floor model with a maximum distance of $42\frac{3}{8}$in. Other than column height and a heavier base the bench model illustrated below is similar in all respects to the floor machine.

The drilling head is a complete unit with the vertical motor drive at the rear and it can be swung to any position round the column. This head and the $8\frac{1}{2}$in square table of the machine can be locked at any required height on the column to suit the work. A $\frac{1}{3}$ h.p. motor drives the spindle through a four-step vee pulley giving four drill speeds of 460, 920, 1840, and 3680 r.p.m. The spindle pulley is independently



**$\frac{1}{2}$ in sensitive drilling machine with four spindle speeds**

mounted on ball bearings, which take the thrust from the driving belt. The splined spindle is driven through a broached bronze sleeve and is supported in a cast iron quill carrying a ball thrust race and two journal bearings. Quill return is effected by enclosed spiral tension springs and the spindle has a maximum travel of $3\frac{1}{4}$in.

## Pneumatic Drill with Automatic Feed Control

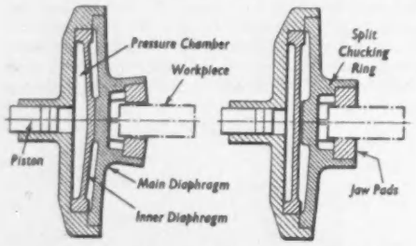
IT is announced that full production has been started by the Climax Rock Drill and Engineering Works, Ltd., Carn Brea, Cornwall, of the $\frac{7}{16}$in Maxam "Woodpecker" drill unit. These units comprise an air-driven drill assembly incorporating a solenoid valve operated hydraulic feed control. This control gives automatic chip clearance by repeated preset relief and feed movements during the drilling cycle, and a rapid approach movement which is reduced to the feed speed on contact of the drill with the work. As the drill is retracted for the relieving stroke, the air supply to the drive is cut off and restored again on the forward feed stroke.

Standard drills of this design have a spindle speed of 2400 r.p.m., but alternative gearboxes can be fitted to give speeds of 540, 970, 4000 and 6000 r.p.m. The two standard units now being made have working strokes of 2in and 4in, respectively.

## Precision Work Chuck

FOLLOWING lengthy experience with a special design of chuck in its own precision production shops the firm of Integral, Ltd., Birmingham Road, Wolverhampton, has started making the chucks for use in industry. These chucks are primarily intended for precision finishing of previously machined components, the chucking size of which is maintained within a tolerance of 0·0002in to 0·003in, depending upon the degree of finished accuracy desired, which, it is stated, can be within a consistent concentricity of 0·00008in.

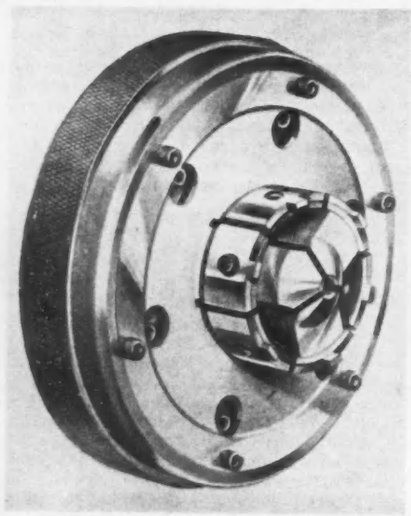
The general construction of this "Everac" hydrostatic work chuck, as it is known, and its




**Diagrammatic arrangement of chuck, showing (left) piston depressed to distort diaphragms and open clamping jaws, and (right) piston pressure released and work clamped in main diaphragm jaws**

principle of operation, can be seen from the diagram we reproduce. The body of the chuck incorporates two steel diaphragms. The outer main diaphragm has an integral split chucking ring on its external face, and three or more detachable jaw pads can be mounted on the sections of this ring to suit the particular work-pieces. An inner diaphragm forms one wall of a chamber filled with hydraulic fluid and its front face is formed with a central boss which corresponds to a similar boss on the inner side of the main diaphragm. The fluid chamber communicates with a small cylinder within which there slides a piston which may be depressed by external means, such as a push rod.

When the piston is pushed inwards, as shown on the left in the diagram, the increase in fluid pressure deflects the inner diaphragm and its boss pushes the main diaphragm outwards. This distortion of the main diaphragm at its centre imparts a small radial outwards movement



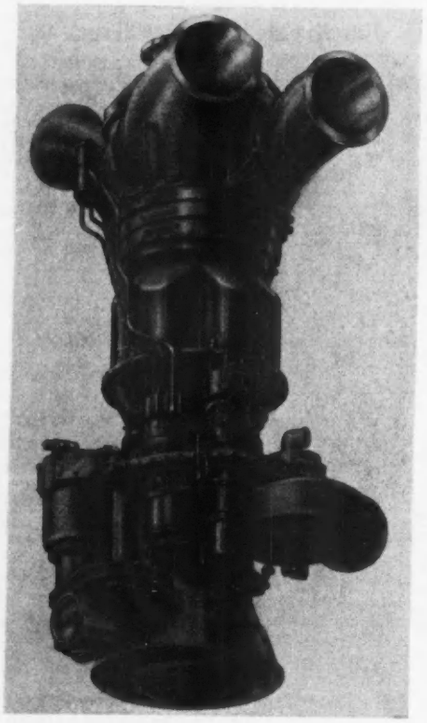
**Hydrostatic work chuck with three jaws in chucking ring and arranged for opening by knurled cam ring round the body**

to the segments of its chucking ring sufficient to admit a component between the jaw pads. On release of the load on the piston the two diaphragms tend to resume their unstressed position under their own elasticity. Complete return of the main diaphragm is prevented by the workpiece between its clamping jaws which then acquire a firm grip on the component. The actual gripping load exerted on the component is determined by the size of the bore previously ground in the gripping jaws, and it is stated that a positive total clamping load of up to 2¼ tons can be applied if required. Such a total clamping pressure, it is claimed, can be applied by exerting a load of only 12 lb on the piston to move it some 0·045in. This load on the piston imparts a pressure of 40 lb per square inch to the fluid in the chamber behind the inner diaphragm. The resultant distortion of the main diaphragm opens the chucking jaws 0·003in in diameter.

The chuck shown in our second illustration has three chucking jaws set in its six-section clamping ring. It has three pistons for the fluid pressure system and these pistons are operated by a knurled cam ring around the body. The jaws are readily interchangeable to suit different work diameters. For long run production work where interchangeable jaws are not required, the main diaphragm can be supplied with a special clamping ring ground to the required size to accept the components.

## Small Aircraft Turbines

A SMALL aircraft gas turbine applicable not only to helicopters but also as a propeller turbine is projected by D. Napier and Son, Ltd., Acton. Few details are available, but, as the name "Gazelle Junior" suggests, the engine is a smaller version of the "Gazelle" helicopter turbine. There is no commonality of parts; it can be seen in our illustration that the engine has a resemblance to the existing unit, but the annular intake surrounding the auxiliaries has been superseded by a nearly straight intake tract. It is not clear to us whether this change is for functional reasons, the flow in the former



**A model of the proposed "Gazelle Junior": the resemblance to a "Gazelle" is clear from the combustion chambers upward**

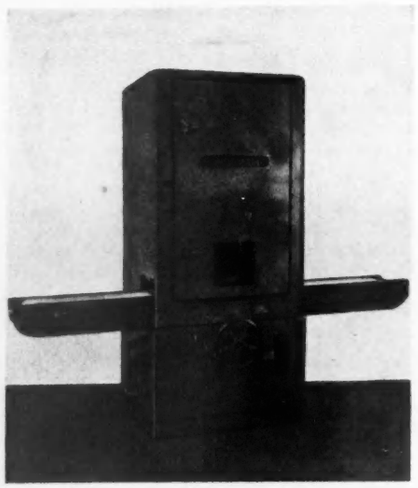
duct having become asymmetric when the intake was moved edgewise through the air, or to allow visual inspection of the variable incidence guide vanes.

The new engine will, it is stated, be offered as a coupled unit, giving the advantages of a twin-engined installation where a single "Gazelle" might have been used or, possibly, allowing heavy mechanical transmissions between a pair of "Gazelle" units to be avoided. The "Gazelle Junior" is rather more than half as powerful as the larger engine; initially it will have a maximum power of 920 s.h.p. ("Gazelle" was 1260 h.p.), a one hour rating of 765 s.h.p., and a continuous rating of 680 s.h.p. After development it is anticipated that the outputs will be 1070 s.h.p. ("Gazelle" will be 1800 s.h.p.), 900 and 800 s.h.p.

Another addition to the engines available in this country may result from the recently announced grant to the de Havilland Engine Company, Ltd., of the right to manufacture the General Electric "T.58" as the D.H. "Gnome." It gives 1024 h.p. and weighs 325 lb with reduction gear; its specific fuel consumption is 0·69 lb per horsepower hour at rated power. It runs in the conventional horizontal attitude; it employs an all-speed governor and, unlike the Napier engines, does not have a torque meter. The first three of the ten compressor stages have variable incidence stators.

## Automatic Feed Abrasive Band Machine

THE abrasive band machine illustrated herewith has been developed by the Globe Metallic Packing Company, Ltd., Queensbury, Bradford, for the automatic grinding and polishing of flat components. It consists essentially of a cabinet



**Abrasive band machine fitted with feed belt conveyor**

body within which there is an abrasive band having a horizontal section above and parallel to the working station of a belt conveyor extending beyond the cabinet sides. The height of the abrasive band in respect to the conveyor can be adjusted in accordance with the work height. Workpieces can be mounted on the conveyor belt by means of suitable fixtures, or if necessary the belt can be replaced by feed roll equipment to suit particular classes of work. For component polishing purposes a motor-driven polishing wheel head can be fitted in place of the abrasive band equipment in the cabinet.

These "Bandomatic" machines are available for use with abrasive bands from 2in to 12in wide and with provision for coolant or dry working. A typical machine to take bands up to 10in wide has an 8 h.p. driving motor giving a band speed of 5000 surface feet per minute. Its conveyor speed is variable up to 40ft per minute and work up to 3in thick can be handled.

---

A "SLIDE CHART" FOR CIVIL ENGINEERING CALCULATION.—Computations in the design of reinforced concrete and in hydraulics can be carried out mechanically on a "slide chart" designed by Mr. W. E. Blackmore and marketed by Kosine, Ltd., 104, High Holborn, London, W.C.1. The r.c. scales relate bending moments, effective depths and steel and concrete stresses. Flows and heads, as given by Manning's formula, are related on the "hydraulics" side of the rule for circular conduits; flows over rectangular weirs and V-notches can also be computed.

# Industrial and Labour Notes

### Wages in 1957

The latest issue of the *Ministry of Labour Gazette* includes a survey of the changes in wage rates which became effective during last year in the United Kingdom. This survey shows that the changes resulted in an aggregate increase of £5,333,800 in the weekly full-time wages of approximately 12,341,000 workpeople. The comparable figure for 1956 is an increase aggregating £6,633,100 in the weekly full-time wages of 12,672,500 workpeople. The index of weekly wage rates (January, 1956=100) rose six points during last year and at the end of December stood at 112 for all workers.

Among the principal changes in wage rates which were made last year, the survey mentions those in coal mining, the iron and steel industry, engineering and shipbuilding, building and civil engineering construction, gas and electricity undertakings, and transport and communication. It will be recalled that in the engineering and allied industries last May men received increases of 11s. a week for skilled grades, 10s. for intermediate grades and 9s. for unskilled grades ; women employed on women's work received an increase of 8s. a week. In the shipbuilding and ship-repairing industry there were corresponding increases for men, and increases of 7s. 4d. to 11s. a week, according to occupation and length of service, for women.

### Industrial Disputes

The Ministry of Labour says that stoppages of work arising from industrial disputes in the United Kingdom last year resulted in a loss of about 8,415,000 working days at the establishments where they occurred. The number of such stoppages which came to the Ministry's notice last year was 2855 and about 1,358,800 workpeople were directly and indirectly involved in them. In 1956, there were 2648 stoppages of work reported to the Ministry, involving 507,800 workpeople and causing an aggregate loss of 2,083,000 working days.

As to last year's stoppages, the Ministry says that about 5·5 per cent of the total number of people in civil employment were involved in them, the loss of time for each worker averaging nearly seven working days. The largest stoppage of work last year, judged by the number of people involved and the amount of time lost, was that of 615,000 or so engineering workers in the engineering, vehicle building and associated industries in various parts of the country in support of their claim for a 10 per cent wage increase. This stoppage began on March 25 and about 4,000,000 working days were lost. A stoppage in the shipbuilding industry, for the same reason, which began a week earlier, involved about 165,000 workers, the loss being 2,150,000 working days. In both cases work was resumed on April 3.

### London Busmen's Wage Claim

It was announced on Monday evening that the representatives of the bus workers employed by London Transport had decided to refer the outstanding claim for a wage increase of 25s. a week to arbitration by the Industrial Court. This decision followed a day of discussion, initiated by the Transport and General Workers' Union, as to what steps should be taken in view of the rejection last week by the Minister of Labour of a suggestion that the matter should be examined by a committee of inquiry.

On Wednesday of last week, the Minister of Labour, Mr. Iain Macleod, was asked in Parliament if he would make a statement about his rejection of the proposal for setting up a committee of inquiry. In his reply, Mr. Macleod recalled his letter, to the Transport and General Workers' Union, which explained his inability to agree to the request for a committee. In that letter, he said, he referred to the possibility of a more general inquiry into the wages situation of the whole of the road passenger transport industry, as well as to the fact that the normal process of arbitration still remained available for dealing with the London dispute.

### The Steel Industry's Future

At the annual meeting, in Sheffield last week, of the United Steel Companies, Ltd., the chairman, Sir Walter Benton Jones, said it might be thought that the directors of steel companies, in opposing nationalisation of the steel industry, were engaging in a party political controversy. If that were a true interpretation of their action, he added, it would be justifiable for them to defend their property from interference damaging to the long-established organisation and routine of steelmaking and distribution of its products.

But, Sir Walter continued, to criticise existing laws or proposed laws was not to criticise a political party. What the steel industry was saying was that as experts their belief was it would be contrary to the interests of the United Kingdom that their industry and industry generally should become the property of the state to the exclusion of private enterprise. The companies had to prove, first of all, that it was a bad thing for steel to be nationalised, and why it was a bad thing. They had to emphasise, Sir Walter said, to those who were opposed to nationalisation that, if steel was to be saved, the eyes of large numbers of people must be opened to the forcible acquisition of property by the state.

### Scottish Industry

In his annual statement as chairman of the Royal Bank of Scotland, the Duke of Buccleuch and Queensberry says that Scottish industry in general has had a fairly satisfactory year. It was not greatly affected by the dislocation of maritime trade and resulting shortage of oil supplies caused by the closure of the Suez Canal during the early part of last year, and the loss of production in engineering and shipbuilding due to the strike in the spring has at least been made partially good. Although orders for new ships fell in the second half of last year, Scottish shipbuilders still have work on hand for many years ahead unless the present depression of freight rates leads to further cancellation of orders.

The statement goes on to say that " Scotland is to have a fair stake in the development of atomic energy " and comments that " it is gratifying to see that the first atomic-powered oil tanker in the world may be constructed on the Clyde." Coal production in Scotland, the statement continues, increased in the first half of last year by 150,000 tons, though unfortunately the improvement was not maintained and the final results for the year were disappointing. Steel output continued to increase in the early months of 1957, but towards the end of the year demand eased and some unused capacity became apparent.

In some comments on economic affairs in general, the Duke emphasises the importance of a high level of capital investment. A criticism of our monetary policy of recent years, he says, is that it has been instrumental in severely curtailing the capital investment programme of the private section of industry and yet has failed to achieve its primary objective of halting inflation. One of the main causes of this failure, the statement goes on, is that the increase in production has not kept pace with the growth in the spending power in the hands of the public, by reason of the simple fact that wage increases have not been offset by increased productivity. To some extent, the Duke suggests, our troubles in this respect have arisen not only from increases in basic wage rates but also from the fact that, in a situation where the demand for labour has been in excess of the supply, employers have been very ready to pay special and overtime rates to attract and retain labour. It has been possible for industry to cover these inflated wage costs, he says, by increasing the prices of its products because of the high level of consumer spending power.

### Synthetic Detergents

The Standing Technical Committee on Synthetic Detergents has presented its first progress report to the Minister of Housing and Local Government. The report says that the quantity of synthetic detergents used domestically and by industry has been increasing at a much slower rate during the last three years. Unless the composition of these products, of which 34,500 tons were used domestically in 1956, alters substantially, therefore, conditions in sewage works, water supply and rivers caused by their use are not likely to change significantly.

The committee, it may be recalled, was appointed to keep under review difficulties arising in sewage works, rivers and water supply caused by these detergents, and to encourage and assist co-ordination of research by manufacturers and suitable public bodies to avoid or overcome the problems without undue burden on public funds. Its report indicates that foam on certain rivers, canals and sewage works is still the most spectacular aspect of the problem. Another aspect considered by the committee is the possible effect of anti-foaming agents used at sewage works on effluents and, therefore, on rivers, and that of the additives present in the retailed detergent powders. The Water Pollution Research Laboratory is experimenting on the toxicity of detergents to fish and on how they affect re-aeration essential for purification of sewage and maintenance of satisfactory river conditions. Present ways of dealing with foaming are palliatives rather than cures, the report says. The committee is satisfied, however, that detergent manufacturers are seriously trying to overcome the difficulties by investigatiing the feasibility of producing efficient household washing products which can be readily eliminated during sewage treatment by present methods. Among the problems here are the need to make a final retail product as acceptable to the housewife as those she can now buy, the desirability of using existing capital equipment, and the availability of the requisite raw materials.

## Annual Report on Swiss Water Power

The Schweizerischer Wasserwirtschaftsverband recently published its annual report for the year 1956. During this period ten hydro-electric power stations were commissioned, totalling 362MW and having a generating capacity of 742 million kWh in the mean year, of which 32·8 per cent is winter energy. This installed capacity represents an increase of 10·3 per cent from 3513MW at the end of 1955 to 3875MW a year later. The power stations were Bürglen (reconstruction), Le Fourcil, La Jougenaz, Laufenburg (reconstruction of two sets), Lienne (power station St. Léonard, at present as run-of-river plant), Maggia (first full impounding of Sambuco reservoir), Mauvoisin (Fionnay and Riddes power stations, at first with small partial impounding of Mauvoisin reservoir), Plan Dessous, Ragaz/Kuranstalten, and Rheinau (first set).

The total production and consumption, including imports and exports of electrical energy, are shown in Tables I and II :

TABLE I—*Power Production at Generator and Imports*
(Millions of kilowatt-hours)

| Hydrographic year | 1953–54 | 1954–55 | 1955–56 |
|---|---|---|---|
| Hydro-electric | 12,994 | 15,381 | 14,660 |
| Thermal | 186 | 67 | 235 |
| Home production | 13,180 | 15,448 | 14,895 |
| Imports | 1,197 | 625 | 1,399 |
| Total | 14,377 | 16,073 | 16,294 |

TABLE II—*Total Consumption and Exports*
(Millions of kilowatt-hours)

| Hydrographic year | 1953–54 | 1954–55 | 1955–56 |
|---|---|---|---|
| Domestic small enterprises, agriculture | 4,801 | 5,101 | 5,603 |
| Federal Railways (SBB) | 887 | 918 | 943 |
| Other railways | 288 | 297 | 309 |
| Industry | 2,075 | 2,238 | 2,399 |
| Chemical, metallurgical and thermal applications | 2,485 | 2,790 | 2,746 |
| Electric boilers | 599 | 847 | 562 |
| Losses, consumption of pumped storage plant | 1,818 | 1,873 | 1,935 |
| Total home consumption | 12,953 | 14,064 | 14,497 |
| Exports | 1,424 | 2,009 | 1,797 |

Because of the continuing dependence on run-of-river plants, it was only by making use of all resources, including heavy imports, that the winter demand could be met.

Exports amounted to 1797 million kWh of which 75·5 per cent occurred during the summer months (April to September), compared with 67·5 per cent during 1954/55. Imports totalled 1399 million kWh of which 85·6 per cent (85·5 per cent) occurred during the winter months.

Total Swiss consumption of electricity rose by 433 million kWh (3·1 per cent), the increase in domestic, small enterprises and agricultural consumption amounting 9·8 per cent, and that of general industry to 7·2 per cent, while chemical, metallurgical and thermal consumption showed a decrease of 1·6 per cent.

## European Nuclear Agency and Eurochemic

On February 1, following the agreement signed in December on behalf of the twelve member countries of O.E.E.C., the European Nuclear Agency began its operation. The Agency, which will function within the framework of O.E.E.C. and under the authority of its council, is to further the development of the production and uses of nuclear energy for peaceful purposes through technical co-operation among the countries of Western Europe.

It will promote the establishment of joint undertakings between those countries, discuss their research and production programmes for nuclear energy, study their requirements for raw materials and capital equipment, work for the liberalisation of trade in these products, develop facilities for the training of specialists and help to finalise and harmonise national legislation, in particular as regards the safeguarding of public health, prevention of accidents, third party liability and atomic risk assurance.

When carrying out these tasks, the Agency will take into account the work done by the other international organisations concerned and will, as far as possible, call on them for assistance. It is provided, in particular, that in view of the special powers attributed by the six countries to Euratom, the Agency will conclude an arrangement with the European Commission as soon as possible, in order to establish close co-operation with Euratom.

The exclusively peaceful character of the Agency's objectives is ensured by a security control guarantee. This is laid down in a special convention which very closely follows the statute of the International Atomic Energy Agency and the Euratom Treaty. Effective safeguards are established by providing for the examination of the plant subject to control; a system of quantitative control for nuclear fuel; on-the-spot supervision by international inspectors and, in cases of non-observance, the possibility of imposing penalties by a majority vote. Provision is made for an international tribunal to settle certain disputes to which the exercise of the control may give rise.

As the Euratom countries have established a complete system of security control, it is specified that control on Euratom territory will be exercised by its bodies under conditions to be settled by an agreement between the Agency and Euratom. Provision is also made for co-operation with the International Atomic Energy Agency in regard to control.

At the same time as these general decisions were adopted by the council, twelve member countries of the organisation reached an agreement to set up a first joint undertaking, the Eurochemic Company. The purpose of this company will be to build and operate a plant for the chemical treatment of irradiated fuel (i.e. a plant for the production of plutonium), which will be erected at the Nuclear Research Centre at Mol (Belgium).

This plant will have a capacity for treating approximately 100 tons of natural or slightly enriched uranium per year. It is expected to cost 12,000,000 E.P.U. units of account and will probably be in operation in 1961.

This undertaking is constituted as a European company with a capital of 20,000,000 E.P.U. units of account (8400 million French francs), set up under an international convention with the participation of Governments, public institutions and semi-public or private undertakings. Certain Governments have stated their intention of transferring their initial participation to private industry.

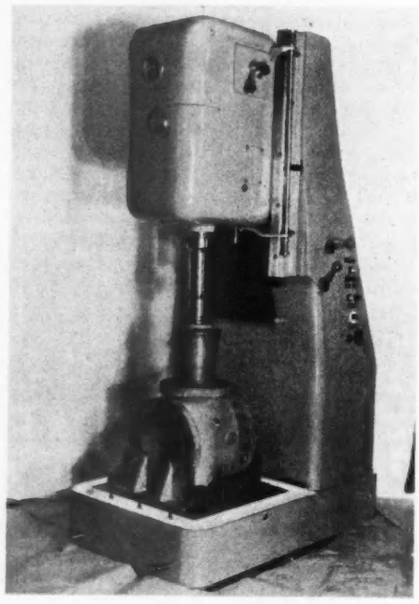
Projects under discussion include the setting up of two other European establishments (the joint operation of the boiling water reactor at Halden (Norway), and the establishment of a homogeneous aqueous reactor at the British Research Centre at Winfrith Heath). Studies are to be made of the possibilities of producing heavy water in Iceland by using geothermic energy.

## French Aviation Developments

For the first time in France, a jet aircraft has been refuelled in flight, on an operation which was recently carried out at Istres. The plane was the SO.4050.02 "Vautour," and it was refuelled by a "Canberra" of the Flight Refuelling Company, which had come to France specially to carry out this operation. The "Vautour's" fuel system had been specially designed for pressure top-up on the ground and for refuelling in flight. The Breguet "Taon" 1001 No. 2, a single-seater light tactical support plane, carried out its maiden flight on January 18 at Villacoublay, flying under the NATO programme. On January 27, the "Caravelle" covered the distance from Paris-Le Bourget to Stockholm in two hours and fifty-three minutes. In Sweden, this aircraft will undergo technical utilisation tests during cold weather, both on the ground and in flight. On January 24 and 27, at Melun-Villaroche, two new automatic ejection seats designed for the bomber station of the "Vautour," were flight tested. They are the models "E.97" with low controls, and "E.92" having a Desgranges et Huaud automatic harness locking device. These tests were carried out using a "Meteor" two-seater aircraft. The monoplane co-operation and observation plane NORD.3400, destined for the observation divisions of the Army, carried out its maiden flight on January 20, from the Melun-Villaroche field, piloted by J. Turcat, assisted by M. Piero. The aircraft has a 240 h.p. Potez 4D30 engine.

## Cock and Valve Lapping Machine

Our illustration shows a cock and valve lapping machine made by Wilh. Beer Spezial-Werkstätten - Wiesbaden, Wiesbaden - Dotzheim, German Federal Republic. This machine, the model "KM-4a," is suitable for fittings up to 12in, depending on the design; versions for 1½in and 4in fittings are also on the market. It is characteristic for these machines that rotation of the cock relative to the valve seat is not continuous, but oscillatory. This is achieved by an electromagnetically operated reversing gear in the headstock, which, in turn, is actuated by a cam. While the direction of rotation is changed, the headstock spindle is raised by means of a cam and forked lever, thus lifting the cock from the valve seat. Since the lengths of travel in



**Model "KM-4a" cock and valve lapping machine for cocks up to 12in**

opposite directions differ, the machined surfaces overlap. It is claimed that this results in perfect roundness and smooth finish of the mating parts.

The headstock moves on slides and its height can be adjusted hydraulically. Abrasive is fed to the workpiece automatically by a pump. For honing work an optional hydraulic control unit can be supplied which imparts an oscillating vertical movement to the spindle.

The headstock spindle centre line is at a distance of 17¾in from the vertical column; maximum clearance between the spindle and the table is 59in. There are nine settings of the spindle speed, ranging from 7 to 45 r.p.m. A main motor of 4 h.p. is fitted; a second motor of 2 h.p. powers the hydraulic system. The machine is equipped with a timing switch, giving cycle times of 36·5 to 365 seconds, or 18·5 to 185 seconds.

### Resharpening of Files

A method for the electrolytic resharpening of worn files is described in *E.P.A. Digest* No. 1727. Several files are suspended in a 56 per cent sulphuric acid solution on a brass frame which is made the anode of the cell, while steel plates on either side constitute the cathode. The cell is operated by a direct current of 100A and 8V to 10V. A lid has to be provided to keep in fumes which must be withdrawn through an exhaust.

*E.P.A. Digests* are distributed free on demand by the Department of Scientific and Industrial Research (T.I.D.U.), Cunard Building, 15, Regent Street, London, S.W.1.

## Portuguese Iron and Steel Works

The construction of a complete integrated iron and steel works near Lisbon has at last been decided on. Following the recent issue of a letter of intent by the Siderurgica Nacional (S.N.), a German-Belgian consortium has been entrusted with the work. Demag is leading partner in a consortium comprising two further German firms, Rheinstahl Industrie-Planung G.m.b.H. and Carl Still, and the Belgian Syndicat Belge d'Entreprise à l'Etranger "Sybetra," the most prominent members of which are the well-known Belgian firms, S. A. Cockerill-Ougrée, S.A. Ateliers du Thiriau, A.C.E.C., and Evance Copée and Cie.

Plans for an iron and steel works on the Tejo have existed for some years. Although quotations were received from German. English, French and American firms as far back as 1955, no final decision was taken owing to differences of opinion in Portugal itself over the proposed site for the works. It is to be assumed that the present negotiations between Spain and Portugal to create a common market area in the Iberian Peninsula have played an important part in the decision.

The initial capacity of the new Portuguese iron and steel works is to be 250,000 tons of ingot steel annually. Proposals have been made for wharfage space for ore, coke and coal ; a coking plant ; blast-furnaces (annual capacity 210,000 tons) ; a sintering plant (7–800 tons per day) ; a steel plant with one 35-ton electric arc furnace and one 30-ton oxygen-blown converter ; finally, rolling mill plant of up-to-date design, comprising one blooming and billet mill, one medium-section and one light-section mill. These rolling mill facilities will ensure an annual output of 150,000 tons of light-section stock and 50,000 tons of medium-section stock.

As far as raw materials are concerned, ore needed for the works will come from native resources. The high-grade Orada and Cercal deposits in the south, as well as the Moncorvo ores will account for the main supply. Plans also exist to use large quantities of Portuguese purple ore in the smelting operations.

The site of the works will be near Seixal to the south of Lisbon. A tributary of the Tejo in the area will have to be dredged to a sufficient depth for coal and ore ships to be unloaded there. The new Portuguese iron and steel works is scheduled to be put into operation early in 1961.

## Second International Conference for Analogue Computations

As a result of the first International Conference for Analogue Computations, organised by the Belgian Society of Telecommunications and Electronics Engineers (S.I.T.E.L.) and held in Brussels in 1955, the International Association for Analogue Computations (A.I.C.A.) was founded. It is the aim of this association to circulate all information which might contribute to progress in the techniques of analogue computations and establish a connection with arithmetical techniques. In order to further this end, the Second International Conference for Analogue Computations is being organised, to be held at Strasbourg on September 1, 1958. This conference, which will last one week, will be devoted to the various systems of analogue computations, to their numerous applications, and to the connections between the analogue methods and the arithmetical methods of computations in electronics. The subject admits of division into four sections: theoretical, mathematical or physical problems ; analogue computation materials ; applications ; the connection between analogue computers and arithmetical calculators. Those who wish to give lectures on present construction techniques and the employment of analogue computations, or to present papers concerned with more limited problems, are requested to contact the organising committee, and to summarise their subject in less than 600 words. The papers are to be published subsequently in the Acts of Congress. All summaries will be translated into French, English and German, and distributed to members of the conference on their arrival at Strasbourg. An exhibition of new equipment is to be held from August 30 to September 8. The charge for participation, including the right to receive all summaries, will be 7000 French francs for firms and 3500 francs for individuals. Those interested are asked to communicate with the organising committee as soon as possible, stating the nature of their participation (exhibitor, speaker or member of the audience). This information should be forwarded to Monsieur F. H. Raymond, Secrétaire Délégué Général de l'Association Internationale pour le Calcul Analogique, c/o S.E.A., 138, Boulevard de Verdun, Courbevoie (Seine), France.

## German-American Reactor Company

Demag Aktiengesellschaft, Duisburg, and North American Aviation Inc., Atomics International Division, Los Angeles, have signed an agreement which provides for the formation of a joint subsidiary to be known as INTERATOM (Internationale Atomreaktorbau G.m.b.H.). An atomic study group had been set up some time ago by Demag. The principal fields of interest of this company are steel making and mining equipment, bulk handling installations and contractors' plant. In adding to these the design and manufacture of nuclear reactors, Demag will be supported by twelve years of experience gained by its American partner. Atomics International Division has a research group of 1600, over half of whom are scientists and engineers. Since 1946, several homogeneous research reactors and two designs of power reactor have been developed. Outside the U.S.A. research reactors have been built in Japan and Denmark, and others are under construction for the Universities of Frankfurt, Berlin and Milan. Of the two power reactor types, one experimental station each is operating in the United States.

A 7500kW variety (20,000kW thermal) of the sodium graphite reactor (SGR) was commissioned early in 1956 and is used as a scale model for a power plant of ten times this output, which is at present being designed for the Consumers Public Power District of Nebraska.

The second test station uses a reactor having an organic fluid as moderator and coolant. It has been running at Arco, Idaho, U.S.A., since this summer and is intended as a prototype for a power plant of 12,500kW (45,500kW thermal) being developed for the City of Piqua, Ohio, U.S.A. It is also considered that this design will find an application as a power plant for ship propulsion.

## Gas Turbine Congress

In conjunction with this year's Universal Exhibition at Brussels, the Polytechnic Faculty of Mons is organising a Gas Turbine Congress which will take place during the period June 4 to 6. Technical lectures will comprise eight papers as follows : L. Beduwe and A. Jaumotte (Brussels), "Synthèse des Possibilités de la Turbine à Gaz dans le domaine de l'Autoproduction" ; P. Chambadal (Paris), "Emploi de la Turbine à Gaz pour la Production d'Energie de Pointe dans les Centrales d'Electricité de France" ; Dr. C. Keller (Zürich), "Possibilités de la Turbine à Gaz à Circuit Fermé dans les Centrales Nucléaires" ; E. Aguet (Winterthur), "La Turbine à Gaz dans l'Industrie Sidérurgique" ; G. B. R. Feilden (Lincoln), "Operating Experience with Ruston and Hornsby Turbines" ; M. W. Tipler (London), "The Present Position and Future Prospects Concerning the Use of Residual Fuel Oils in Gas Turbines" ; R. Huber and P. Szereszewzki (Paris), "Energie en Jeu dans un Générateur à Pistons Libres" ; J. Szydlowsky (Bordes) B.-P., "Les Turbines à Gaz de Petite Puissance" ; and C. Huber (Baden), "Intégration de la Turbine à Gaz dans les Procédés Chimiques." Visits are to include the laboratories of the Faculty, and the two gas turbines of the Société Métallurgique Hainaut-Sambre at Couillet. Those interested are asked to write to the Sécrétariat Général des Journées Internationales de la Turbine à Gaz, Faculté Polytechnique de Mons, 9 rue de Houdain, Mons (Belgium).

## Appointments to EEC and Euratom

On January 6 and 7 the Foreign Ministers of the six European countries that have united to form the European Economic Community met in Paris to confer on top-level personnel appointments.

They agreed that as soon as it becomes feasible all European institutions should be established in the same place. To decide finally on this location, the Foreign Ministers will re-assemble not later than June 1, 1958.

In respect of the European organisations, the following appointments were made : W. Hallstein (Germany), was appointed president of the EEC Commission; P. Mansholt (Netherlands), and R. Marjolin (France), were made Vice-Presidents.

Members are : R. Lemeignan (France), G. Petrilli (Italy), M. Rasquin (Luxemburg), J. Rey (Belgium), and a representative from Germany yet to be named. L. Armand (France), was made President of the Euratom Commission and E. Medi (Italy), Vice-President.

Members are : P. de Groote (Belgium), H. Krekeler (Germany), E. Sassen (Netherlands), and a representative from Luxemburg yet to be named. President of the Board of Governors of the European Investment Bank is P. Campilli (Italy), and vice-presidents are one representative each from France and Germany.

In addition, the Foreign Ministers agreed to appoint Franz Blücher, former Vice-Chancellor and Federal Minister for Economic Co-operation, a member of the High Authority of the European Coal and Steel Community.

## Manpower and Factories in Switzerland

The Swiss Inspectorate of Factories recently published its report covering the years 1955 and 1956. During the period under review, the very favourable trading situation resulted in further industrial expansion with a consequent increase in the manpower shortage. Between the end of 1954 and that of 1956, there has been an increase of 404 (3·5 per cent) in the number of registered factories (904 additions, 500 deletions), their numbers increasing from 11,587 to 11,991, as compared with 11,201 in 1950. The increase was very noticeable in the metallurgical sector (+124), in the engineering industries (+96), the woodworking (+50), watchmaking (+43), and clothing industry (+41). Industrial manpower rose from 564,311 to 614,436 (it stood at 492,563 in 1950). Because of the labour shortage, increasing numbers of foreign workers were employed, forming 11 per cent of the total in 1954 (62,106) and 15·8 per cent in 1956 (97,332).

## Swiss Search for Fissile Material

Improvements in the technique of prospecting and the realisation that certain elements can be of commercial value even if found only in small quantities, has led to a renewed interest in Switzerland in investigating whether there are any worthwhile native deposits of uranium ore. A working group has been formed for the study of Swiss rocks and minerals with regard to their content of fissionable material and other rare substances. The work is to be carried out systematically, both at the surface and underground. One of the most urgent parts of the work will be to survey the galleries and tunnels of hydro-electric installations while they are still accessible during their construction.

## AGARD Ballistics Meeting

The AGARD Wind Tunnel and Model Testing panel will sponsor a meeting in Freiburg (Breisgau), Germany, from April 22 to 25, 1958. This meeting will commemorate the centenary of Carl Cranz. The subjects which will be discussed during the four-day meeting will include the historical development of ballistics, high-velocity guns, range techniques and long-range missiles. As in all other AGARD Panel meetings attendance is upon invitation of AGARD national delegates from the NATO countries. Approximately fifteen papers will be presented and discussed.

# The American Scene

BY OUR AMERICAN EDITOR

## Doubled Power Level of Experimental Boiling Water Reactor

THE Experimental Boiling Water Reactor (EBWR) at the Argonne National Laboratory of the U.S. Atomic Energy Commission, at Lemont, Illinois, has been successfully operated at a power level of 50MW of heat, more than double its design level. The 50MW level was attained on December 23, 1957, with no change in the number or the arrangement of the fuel elements within the reactor core. The increase in the thermal output of the EBWR is a result of ten months of experimentation. Such an increase in the thermal output would potentially increase the plant's electrical output, and the increase in the electrical output would theoretically make possible a reduction in the cost of the electricity. In the case of the experiments with the EBWR the electrical output was increased only to 6250kW which is the maximum capacity of the turbo-generator portion of the plant. The amount of heat in excess of that required to produce the 6250kW was disposed of by condensing in the main condenser the excess steam that was generated.

The EBWR was designed to produce 20MW of heat and 5MW of electricity with natural circulation of the core coolant. These original levels of design power and electrical output were achieved on December 29, 1956, shortly after the reactor was first placed into operation. The 50MW operating level was achieved with natural circulation of the water coolant in the core of the reactor. The water was caused to boil at a higher than normal rate, resulting in faster circulation through the core and in a more rapid removal of heat. The plant operated in a stable manner at the increased power level. It is believed, on the basis of the tests made, that the maximum stable power of which the present EBWR is capable may be still higher than that achieved. In addition, calculations indicate that with modifications the EBWR could produce up to 100MW of heat and 25MW of electricity. This level of operation would require the addition of more fuel and a turbo-generator and condenser of larger capacity than those of the present plant. The EBWR is the first nuclear reactor built by the U.S. Atomic Energy Commission having as one specific purpose the experimental generation of electricity. The power generated by the EBWR is consumed at the Argonne National Laboratory.

## 30,000,000 lb Plate Stretcher

THE Kaiser Aluminum and Chemical Corporation of Oakland, California, has placed an order with Hydraulik G.m.b.H. of Duisburg for the construction of a 30,000,000 lb plate stretcher to be installed as part of the heavy plate facilities at the company's Ravenswood rolling mill in West Virginia. The stretcher will be able to handle a maximum cross-section of 640 square inches. Within this overall limit, it will accommodate thicknesses up to 6in and widths up to 160in, in lengths from 17ft to 60ft. Together with associated heat treating and ultrasonic testing equipment, the stretcher will be installed to supply the increasing demand of aircraft builders for larger and thicker plate in the strongest aluminium alloys. In addition, demand is growing in the United States for heavy aluminium alloy plate for uses in the road transport and shipbuilding industries.

At the Ravenswood works the stretcher will be installed in a pit 120ft long, 32ft wide and 15ft deep. The top of each stretching head will rise 8ft 6in above floor level. The machine will be without a guiding frame and will be free to move on tracks supported on a foundation, with no effort being made to hold it in a rigidly fixed alignment. Each head will be supported on each side by eight standard railway car wheels on a double track. The forged steel working columns of the machine are 42in in diameter. The column on each side is actually divided into two columns, each 35ft long, separated by a large stretching cylinder which is designed to operate at a hydraulic pressure of 6000 lb per square inch. One of the columns is solid, and the other one is hollow in order to act also as a manipulating cylinder. The hydraulic system will keep the two sides of the machine parallel, completely independent of the load and its positioning in the jaws. Instead of the conventional "C" frame design for the heads, there is a top head and bottom head held together by six forged alloy tie bolts 15in in diameter and 15ft long. This approach avoids the creation of excessive design stresses and provides an open back design which permits a more effective jaw arrangement.

Arrangements have been made to absorb the tremendous forces that would be released should a plate break while being stretched near full capacity. Shock absorbers are provided between the ends of the pit and the columns. The stretcher jaw mechanism also includes a hydro-pneumatic system similar to the recoil mechanism of a heavy cannon which is capable of absorbing over 15,000,000 ft-lb of energy in each head. When a broken plate moves back into the jaws, the jaws will release it by their wedging action and the plate will fly free through the open back of the head and encounter an outside bumper that will absorb its energy.

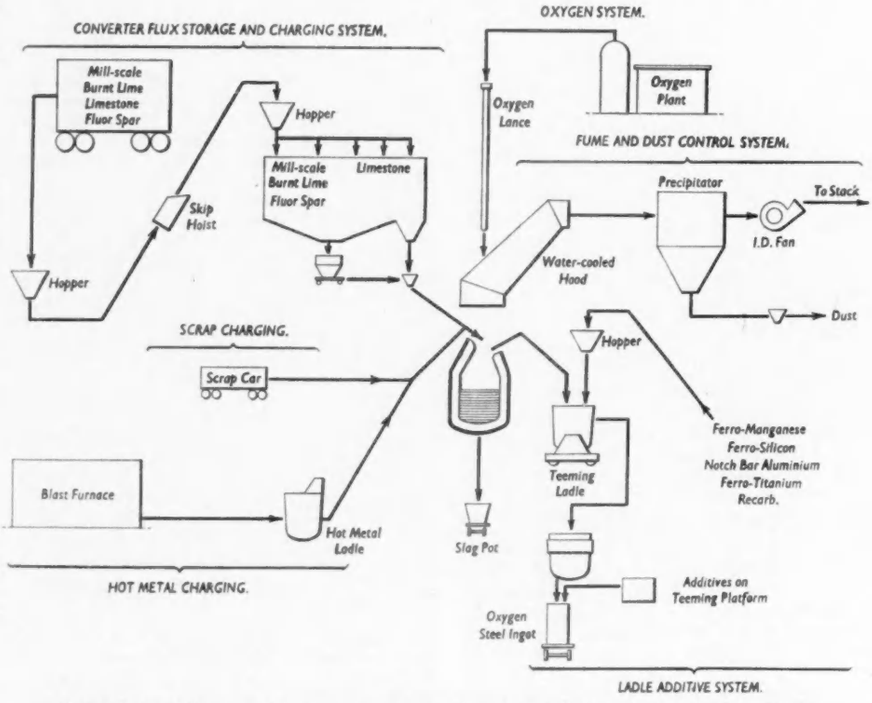
Hydraulik G.m.b.H. is supplying all of the mechanical parts of the stretcher to designs prepared by Kaiser Aluminum. The stretcher is scheduled for delivery and installation by 1959.

# Basic Oxygen Steelmaking Plant

PRODUCTION of steel by the basic oxygen process recently began at the Aliquippa Works of the Jones and Laughlin Steel Corporation in Pennsylvania. It was the start of an operation that is expected to have a far reaching effect on the American steel industry. Jones and Laughlin is the first major steel company in the United States to use the basic oxygen steelmaking process. The two furnaces involved have a total annual rated capacity of 750,000 tons and are believed to be the largest in the world. The cost of the complete installation was about 11,000,000 dollars.

The basic oxygen process not only produces high-quality steel, but the facilities can be constructed at a cost much lower than that required for traditional steelmaking methods. The present basic oxygen furnaces represent a capital investment of only 15 dollars per annual ingot ton as compared with at least 40 dollars per annual ingot ton required in the United States for new open hearth facilities. The basic oxygen steelmaking process is a relatively simple one. It is carried out in a cylindrical furnace lined with basic refractories. The furnace is charged with scrap, with molten iron and with slag forming materials.

The two basic oxygen steelmaking furnaces at the Aliquippa Works resemble Bessemer converters, although there are no tuyeres, wind box, or blast pipe. Furthermore, since the bottom linings are not unduly worn in the oxygen process, there is no need for a removable bottom as in the case of Bessemer converters. The refractory lining of the furnace is about 38in thick and usually consists of a permanent lining of magnesite brick and an interior lining of pressed tar-dolomite brick with a layer of a rammed mixture of tar-dolomite between the permanent and working linings. The operation of the furnace is a relatively simple one. The charging is similar to regular converter practice




**Materials flow diagram of basic oxygen process furnace installation at the Aliquippa Works**

**Basic oxygen process furnace at the Aliquippa Works being charged with hot metal from the blast-furnaces**

and begins with the vessel being tilted to receive the scrap charge, amounting to 25 to 30 per cent of all metallics used. This is followed by hot metal and small quantities of roll scale and lime. The furnace then is tipped upright and a water-cooled oxygen lance is lowered to a predetermined position above the surface of the bath. The oxygen is turned on using a pressure which is usually between 100 lb and 150 lb per square inch, and an instantaneous reaction occurs, leading to the formation of FeO, of which part goes into the slag and part enters the bath by diffusion. Carbon monoxide is evolved which starts a vigorous boiling action reaching to all parts of the charge. In the central reaction zone, temperatures are developed close to the boiling point of iron, which enhances the solubility of the oxygen and accelerates the diffusion of FeO throughout the bath, thereby resulting in a rapid oxidising process. The carbon reaction speedily diminishes the FeO content of the slag. The conclusion of the process is marked by a clearly visible drop in the flame at the furnace mouth. At this point the oxygen lance is withdrawn and the furnace is tilted to a horizontal position to permit the skimming off of fluid slag, after which it is rotated to the opposite direction and the steel is poured into a conventional ladle.

Only one furnace will be in operation at a time. While one is making steel, the other will be relined, a job that takes about five days. The furnaces will produce at least 54 tons of steel per heat, and a heat will take about 37 minutes. In a 24-hour operating day, production will approximate forty heats. The life of the lining is estimated at between 300 to 400 heats. Steel made by this process will be quite low in content of nitrogen, phosphorus and sulphur. Hence, the steel produced by the basic oxygen process is characterised to a great extent by its high purity and ductility. At Aliquippa the steel from the oxygen furnaces will be applied to the production of welded pipe, tin plate, cold heading wire, welding rods and light structural sections. One of the innovations on the present installation is a system for preventing air pollution from the furnaces. Large electrostatic precipitators have been installed which are designed to remove the suspended matter from the waste gases of the furnaces. Water-cooled hoods have been built directly above the furnaces. The gases are drawn into them by fans capable of moving more than 200,000 cubic feet of gases per minute. The gases are sprayed with water to remove the heavier material and to lower the temperature from 3000 deg. to less than 500 deg. Fah. The electrostatic precipitators then remove the fine dust. The principal auxiliary to the furnace shop is an oxygen generating plant built by Air Products, Incorporated. It contains two units, each capable of generating daily 115 tons of high purity (99·5 per cent) oxygen. Less than 2000 cubic feet of oxygen are needed to produce a ton of steel in the basic oxygen process. The storage facilities at the Aliquippa Works will hold as liquid the equivalent of 6,000,000 cubic feet of gaseous oxygen.

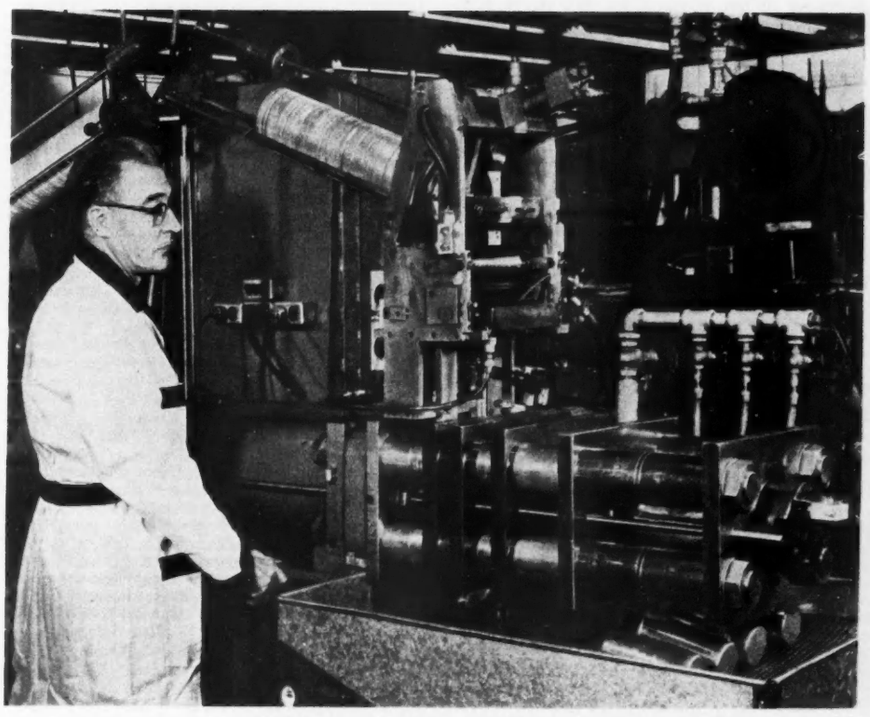
The basic oxygen furnaces eventually will mean a net increase at the Aliquippa Works of 400,000 annual ingot tons. The decision to utilise the basic oxygen process was made by the firm after a thorough study of the economics and other factors involved in several other steelmaking processes. It was decided that the conditions at Aliquippa were best suited for the basic oxygen process. Aliquippa has five blast-furnaces, giving it a good supply of hot metal, and enough mill scrap is produced to provide the quantities used in the basic oxygen process. Although the basic oxygen process is essentially a European development, numerous refinements have been incorporated into the present installation.

## Deep Drawn Aluminium Containers

A NEW drawing technique for the commercial production of seamless aluminium cans has been developed by the Kaiser Aluminum and Chemical Corporation, of Oakland, California. The company recently announced that it had installed a commercial prototype can-making facility at its container works in Wanatah, Indiana, and had started production of an initial order of 5,500,000 cans for the Kraft Foods Division of the National Dairy Products Corporation. The Kraft cans will be used to package grated cheese and are the first aluminium food cans to be manufactured commercially on a large scale production basis in the United States. Kaiser Aluminum has already delivered to the U.S. Air Force its current requirements for aluminium cans for packaging precision bearings and a substantial quantity of cans to the Air Reduction Company for use in packaging stainless steel welding rods. Kaiser Aluminum will offer its aluminium can making methods to can manufacturers and will continue its present work with them in the adaptation of aluminium to conventional three-piece can operation.

Among several aluminium can-making techniques Kaiser Aluminum is developing is a new drawing process which was perfected during the past two years by the corporation's container development group in Chicago. This process produces a seamless can body and bottom in one piece by advanced techniques in the deep drawing of aluminium sheet. Because of its high protective qualities and attractive appearance, the seamless aluminium can is expected to find widespread use. Although their unit cost may be higher initially in some instances, aluminium cans will be entirely competitive with other types of containers where it is possible to make effective use of the special properties of aluminium. Under conventional deep drawing methods, it usually is not possible to perform a greater draw than 50 per cent of the diameter in one stroke. Thus several forming operations are required to bring the can body to its desired shape and size. With the present method, however, the can body may be formed in a single operation. In fact, it is now possible to produce seamless can bodies with a depth of up to three times their diameter in a single stroke.* This technique also makes possible the production of rigid durable cans with walls as thin as 0·005in. With the new process it is easy to vary the size and shape of deep drawn cans for production on the same equipment. The can-making unit also requires only a small fraction of the floor space required by conventional can manufacturing equipment. From the standpoint of protection the fabrication of a seamless can body from a single disc of aluminium virtually eliminates the danger of leakage. Furthermore, the non-sparking characteristic of the metal makes it an ideal container for inflammable materials.

* In this operation the punch draws the aluminium blank through the cupping, ironing and bottoming dies in the one stroke of the press.



**Special-purpose press developed by Kaiser Aluminum for the production of deep-drawn aluminium cans, with a single stroke of the punch drawing the blank through the cupping, ironing and bottoming dies**

# Personal and Business

## Appointments

MR. B. A. HENSLER has been appointed a director of Siemens Edison Swan, Ltd.

MR. T. N. RISK and MR. G. G. T. WRIGHT have been appointed directors of the Mine Safety Appliances Company, Ltd.

MR. L. A. STEVENS has been appointed manager of a newly formed material handling department at F. Perkins, Ltd.

ROWEBB, Ltd., announces that Mr. R. Keanie and Mr. C. C. Laing have been appointed sales representatives in Scotland.

MR. KENNETH ROBINSON has been appointed promotion officer to the Council of Industrial Design in succession to Mr. Morris J. Brown.

MR. A. D. SMART has been appointed finance manager of the British Oxygen Company, Ltd., and has been succeeded as secretary by Mr. B. R. D. Clark.

MR. J. ALLAN PERHAM has been appointed resident director of the Atlas Copco companies in the United States. Mr. Erik Johnsson has been appointed sales director.

LLOYD'S REGISTER OF SHIPPING has announced the appointment of Mr. A. T. S. Sheffer as principal surveyor, Liverpool, in succession to the late Mr. G. Pickering.

Mr. T. H. WEST has been appointed P.R.O. to E.M.I. Electronics, Ltd., Hayes, and has been succeeded as press officer of the Automatic Telephone and Electric Company, Ltd., by Mr. John Hawkins.

THE LOCOMOTIVE AND ALLIED MANUFACTURERS ASSOCIATION OF GREAT BRITAIN has announced that Sir George H. Nelson, Bt., has been appointed president and Mr. G. T. Owen, chairman of the Association.

THE PYRENE COMPANY, Ltd., states that Mr. H. F. Parshall has taken over board responsibility for the metal finishing division, and that Mr. W. E. Wright has retired from the board of directors and from control of that division.

CARRON COMPANY has announced the following appointments :—Mr. J. I. Paton has been appointed sales manager ; Mr. W. Thomson, chief technical representative, and Mr. J. MacPherson, works manager of engineering department.

MEGATOR PUMPS AND COMPRESSORS, Ltd., has announced that Mr. A. Billingham, its technical representative in the Midlands, is to take up an appointment with Megator Pumps and Compressors Inc., Pittsburgh, U.S.A. Mr. Billingham has been succeeded in the Midlands by Mr. N. H. MacPherson.

MR. W. D. OPHER, M.I.Mech.E., has been appointed managing director of Vickers-Armstrongs (Engineers), Ltd., in succession to Mr. P. H. Muirhead. Mr. Muirhead has resigned his appointment as managing director and his directorship of that company, but retains his other group directorships. Mr. W. D. Opher and Mr. R. P. H. Yapp have been appointed special directors of Vickers, Ltd.

REYNOLDS TI ALUMINIUM, Ltd., announces the following appointments as directors :—Sir Ivan A. R. Stedeford, chairman, Mr. R. S. Reynolds, Jnr., alternative chairman, The Lord Reith, P.C., Mr. W. G. Reynolds, Mr. J. L. Reynolds, Mr. J. H. McConnell, Mr. A. J. S. Aston and Mr. R. D. Young. Mr. Paul R. McGehee has been appointed chief executive (manufacturing and technical) and Mr. Basil James, chief executive (sales).

WAKEFIELD-DICK INDUSTRIAL OILS, Ltd., has announced the appointment of Mr. J. W. Macmahon as general manager of its industrial lubricants division in succession to Mr. R. J. Turner, who has retired. Mr. MacMahon has also been appointed a director. Mr. C. R. Woodfield, works production manager, has been appointed a director. The company has also announced the following field staff appointments ; Mr. C. W. Page, Mr. D. S. Kirkpatrick, Mr. F. Rogerson and Mr. H. B. Towle, have been appointed regional sales managers, and Mr. M. Nicol has been appointed regional sales promotion manager.

## Business Announcements

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has announced that Mr. E. G. James, A.M.I.E.E., has retired after thirty-nine years' service.

OPTICAL AND MECHANICAL DEVICES states that with effect from February 1, it has been re-formed as Optical-Mechanical (Instruments), Ltd., 17, Station Road, Egham, Surrey, (telephone, Egham 3120).

MR. N. DEVONALD, A.M.I.E.E., has retired after forty-five years' service at the Rugby and Willesden works of the British Thomson-Houston Company, Ltd.

MR. HUGH H. BAIRD has resigned his directorships of Baird and Tatlock (London), Ltd., and Hopkin and Williams, Ltd., and has left this country for Australia.

CHAMBERLAIN PLANT, Ltd., Staffa Works, Leyton, London, E.10, states that it has been appointed sole distributor for Eire for the Jenbach J.W.78. diesel-driven air compressor.

MR. W. J. W. PROCTOR, sales director of Follsain-Wycliffe Foundries, Ltd., is to visit Johannesburg and district, and will then make a sales survey of north and south Rhodesia. Mr. Proctor will arrive in Johannesburg at the end of February.

THE CAMLEN CHEMICAL COMPANY announces that it is extending its marketing activities in southern Africa, and that it is forming a subsidiary company there under the management of Mr. J. A. Vorster, Mr. Vorster will leave on March 6, to take up residence in Durban.

W. H. DORMAN and Co., Ltd., states that Mr. J. W. Whimpenny, joint managing director, and Mr. Ian MacLeod-Smith, general sales manager, have left by air to visit its associated company in Toronto and its Canadian agents. Mr. Macleod-Smith will subsequently tour central and south America and the Carribean area.

IMPERIAL CHEMICAL INDUSTRIES, Ltd., has announced the formation of Yorkshire Imperial Metals, Ltd., Haigh Park Road, Leeds. The board of directors has been constituted as follows :—from I.C.I.: Dr. James Taylor (chairman), Mr. Peter T. Menzies, Dr. Maurice Cook, Mr. Michael J. S. Clapham, Mr. St. John Elstub, Mr. Harold Royle, and Mr. Walter N. Ismay; from Yorkshire Copper Works, Ltd.: Mr. George P. Norton (deputy chairman), Mr. H. F. Sherbourne (managing director), Mr. W. R. D. Macdonald, Mr. C. G. Robinson, Mr. Donald Fraser, Mr. J. Christie, and Mr. Clifford Breckon. The company's secretary is Mr. P. D. Peel Yates.

## Contracts

MATTHEW HALL AND CO., Ltd., has received a contract for the design, procurement, construction and commissioning of the new chemicals building at the factory of Joseph Crosfield and Sons, Ltd., at Warrington. The contract, valued at approximately £1,000,000, covers a new plant for the manufacture of industrial detergents, silica gels and other chemicals.

## Miscellanea

HAMMER FACTORY.—A new factory for the manufacture of hammers has been opened at Ecclesfield by Stanley Works (G.B.), Ltd., and initially production is being confined to claw hammers. The factory is planned for manufacturing on a line production basis and incorporates many of the processes used in the Stanley works in the United States.

RUGBY TECHNICAL COLLEGE.—The Warwickshire Education Committee has announced the receipt of the first instalment of a gift of £25,000 made by the British Thomson-Houston Company, Ltd., to the Rugby College of Technology and Arts, as a part payment of the cost of the halls of residence now being erected in the College grounds.

1958 BRITISH ELECTRICAL CONFERENCE, BRUSSELS.—We learn that accommodation in hotels in Brussels for the above conference is difficult to obtain, and any intending delegates who want accommodation secured for them must notify their requirements to The Organising Secretary, 1958 British Electrical Conference, 36, Kingsway, London W.C.2, not later than Tuesday, February 11, after which delegates will have to make their own arrangements for accommodation.

ASSESSMENT OF SURFACE TEXTURE.—A new publication in the series of " Codes of Practice " issued by the Ministry of Defence, is entitled *A Guide to the Assessment of Surface Texture*. The object of this guide, which is based on B.S. 1134 : 1950, is to make available to designers, producers and inspectors the essential information necessary for them to use up-to-date techniques on surface finish assessment in an intelligent practical manner. The guide is available from H.M. Stationery Office and costs 3s.

INSTITUTE OF REFRIGERATION.—The fifty-eighth anniversary dinner of the Institute of Refrigeration was held at the Savoy Hotel, London, on Wednesday, January 29, and was attended by over 600 members and guests with the President, Lord Dudley Gordon, in the chair. Sir Rupert De la Bere proposed the toast of " The Institute of Refrigeration " and in his response the president mentioned that he was to be succeeded in his office by Sir Rupert. Mr. C. M. Brain proposed the toast of " The Guests " and remarked that the National College was now producing a small stream of technologists for the industry. He appealed for greater support for the college and was pleased to note that £150,000 had been made available from Government funds for the construction of a new building.

CABLE MAKERS FEDERATION.—The inaugural meeting of the Cable Makers Federation was held on January 7. The aim of the Federation, with its initial membership of about forty British cable makers, is to act as a forum whereby problems of common interest to the industry can be discussed. It is stated that the Federation will not be concerned with price fixing or related activities ; nor will it replace the existing Cable Makers Association, Independent Cable Makers Association or other similar trade associations.

EARTH BORING ATTACHMENT FOR TRACTORS.—An earth boring attachment, which can be mounted directly on the three-point hydraulic linkage of a heavy wheeled agricultural tractor and used for boring holes for posts, poles, foundations, &c., down to a maximum depth of 12ft, with augers from 6in to 24in diameter, has been developed by Transplanters (Robot), Ltd., Guildford Road, St. Albans, Herts. It is designed for quick and easy attachment to and removal from a tractor, and the drive is taken from the tractor power take-off through a double reduction gearbox.

PRESS NUTS FOR SHEET METAL.—A licence has been acquired by the Instrument Screw Company, Ltd., Northolt Road, South Harrow, Middlesex, for the manufacture in this country of the " Rosan " press nut for use with sheet metal components, to provide a deep tapped hole. These nuts have a recessed spigot on one side which is inserted into a hole in the metal. On the other side of the nut then being covered with a hollow punch and struck the metal flows into the recess of the spigot. The grip so obtained is supplemented by teeth machined in the face of the nut penetrating into the surface of the metal.

SCAFFOLD JIB CRANE AND A PLATFORM HOIST.—An improved scaffold jib crane for use on building sites, which has been developed by the British Hoist Crane Company, Ltd., Compton, Berks, is designed to raise a 5 cwt load at 4ft 4in radius at a speed of 110ft per minute, and a 3 cwt load at 220ft per minute. It has a two-speed winch driven by a 3½ h.p. Lister oil engine. A new platform hoist, known as the " Moonraker Mark 3," has also been introduced by the firm. This hoist can be used to elevate loads of 2½ tons at speeds of more than 100ft per minute. Its winch drum takes sufficient rope for platform heights in excess of 300ft, and is driven by a 24 h.p. diesel engine.

RUST-INHIBITING CALCIUM PLUMBATE PAINT.—A new colour film featuring " Rustodian," a rust inhibiting calcium plumbate paint, was shown recently in London by Associated Lead Manufacturers, Ltd. The film shows some of the exposure tests to which the paint has been subjected in the Shetlands, and also a series of carefully controlled laboratory tests. It is claimed that because of its particular qualities of adhesion " Rustodian " is a suitable primer for most metals and for new, un-etched galvanising. The film concludes with sequences demonstrating the variety of applications to which the paint is suited, particular emphasis being given to marine work. The film runs for twenty-two minutes and is available in Eastman colour, 16mm size.

FLAME-FAILURE EQUIPMENT.—A fully automatic flame-failure and ignition-programming controller that has been announced by Elcontrol, Ltd., 10, Wyndham Place, London, W.1, is for use with industrial oil or gas burning equipment. The unit uses an infra-red cell as the flame detector and embodies an a.c. amplifier so that it responds only to the fluctuating infra-red radiation characteristic of flames and is not affected by glowing refractory. Styled the " FSM4," the controller is of the same size as other standard " Elcontrol " units, 13in by 8in by 6in, and is housed in a steel case with hinged lid. It is also supplied in chassis form or in weather-proof cast iron or aluminium box. The chassis is readily withdrawable. The " FSM4 " is for use with spark-ignited burners, or with spark-ignited gas or light-oil pilots, which may be on or off after establishment of the main flame, and it operates in conjunction with various kinds of temperature control. The unit is said to enforce a safe lighting sequence, including fan starting, a pre-purge period, a fixed " failure-to-ignite " time, and automatic shut-down and lock-out on flame failure and on failure to light within the programmed time. It can be used in conjunction with oil preheating arrangements, in which case the start of the ignition cycle is delayed until the oil is at correct atomising temperature.

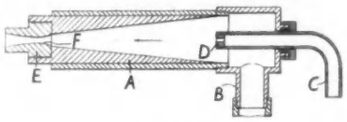
# British Patent Specifications

*When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.*

## FURNACE-FIRING

**788,602.** November 11, 1953.—OIL BURNERS, The British Iron and Steel Research Association, 11, Park Lane, London, W.1. (*Inventor: Maurice Purcell Newby.*)

The invention relates to apparatus for and method of producing an atomised jet of a liquid by the use of a gas under pressure. A particular object is to provide an oil burner in which either less steam can be used to burn a given quantity of oil in a given length and thus enable higher flame temperature to be obtained, or a shorter and more intense flame can be produced for the same consumption of steam. The oil burner shown in the drawing comprises a conically tapered conduit *A* into which the steam is led under pressure through the piping *B*. Oil under pressure



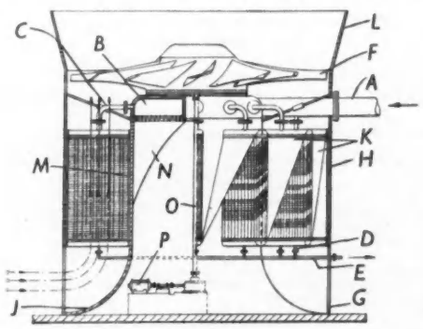

No. 788,602

is supplied to the conduit by the piping *C* which has at its end a conventional oil nozzle *D*. The oil is supplied under pressure only slightly in excess of the pressure of the steam so that there are only small friction effects between the oil and steam on entry of the oil into the conduit. The oil becomes entrained in the steam in the conduit *A*, but, because the angle of the taper is small, there is little acceleration of the steam before it enters the nozzle proper. At the forward end of the conduit *A* there is a nozzle *E* having a convergent part *F* and a continued divergent part. The profile of the nozzle *E* is designed to produce a substantially uniform acceleration of the oil and steam so that energy losses in the nozzle are minimised. The oil is thoroughly atomised in the nozzle and emerges therefrom as a highly atomised and turbulent jet. The tapered conduit *A* is not essential to operation of the burner and may be dispensed with. Modified designs are also shown in the specification.—*January* 2, 1958.

## STEAM POWER PLANTS

**789,011.** January 3, 1955.—AIR-COOLED CONDENSERS, Maschinenbau-Aktiengesellschaft Balcke, 5, Marienplatz, Stammhaus, Bochum, Germany. (*Inventors: Fritz Murray and Heinrich Grett.*)

According to the invention there is provided a condenser in which steam is condensed under vacuum in finned tubes by air as a cooling medium sucked in by a fan. As shown in the drawing, the steam enters through the steam supply pipe *A* into the



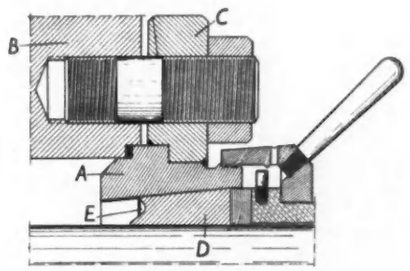

No. 789,011

central steam distributing chamber *B* provided with guide walls for the uniform distribution of the steam, from there through the steam connecting tubes *C* to the individual elements, where it condenses inside the individual tubes of the elements and is conducted as condensate through the discharge tubes *D* to the outlet *E*. The cooling air sucked by the screw fan *F* passes through the openings *G* in the cylindrical casing *H* between, but below the lower rim of the radially disposed elements, into the apparatus and is conducted over guiding surface *J*, guiding plates *K*, through the finned tubes on the whole width of the elements and leaves the condenser heated through the diffuser *L* above the fan. In the region of the elements the air according to the invention is positively conducted for each element separately. Each guiding plate *K* is fixed by its lower part to the lower rim of an element and by its upper part to the upper rim of the next following element. Laterally the bordering of the air passage associated with each element is done by the cylindrical walls of the inner casing *M* and the outer casing *H*. In order to decrease the air resistance of the individual elements the fins of the tubes are disposed at an acute angle to the axis of the individual finned tubes. In the case of large plants the outer and inner casings may be constructed of concrete and stiffening ribs *N* may extend upwards from the inner casing *M* towards the surface for supporting the steam distribution chamber *B* and the fan *F*. The fan shaft and fan driving motor are indicated at *O* and *P* respectively. The advantages of the radial arrangement of the elements according to the invention as compared to the arrangement of the elements on the periphery are explained in full detail in the specification.—*January* 15, 1958.

## INTERNAL COMBUSTION ENGINES

**789,199.** March 15, 1956.—PISTON-ROD STUFFING-BOXES, S. N. Marep, 21, rue Jean Nicot, Paris VII°, France.

The invention relates to piston-rod stuffing-boxes and is concerned with those wherein an externally conical packing is employed. As shown in the drawing *A* is a stuffing-box which is attached to a pump body *B* by a flanged ring *C*, which engages an annular



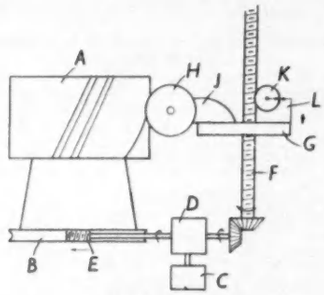

No. 789,199

shoulder on the body. The stuffing-box packing *D* is an externally conical elastic body, preferably of rubber, with an axial cylindrical bore for the passage of the piston-rod of the pump. When the packing is inserted into the stuffing-box chamber with its smaller diameter end in the lead and is gently forced inwards, a tightening of the packing is effected. The smaller diameter end of the packing is not abutted against a surface or radial wall, but is freely exposed to the pressure in the pump body. Advantageously, and in accordance with the invention, the smaller-diameter end of the conical packing is formed with an annular recess *E*, which is bounded by an outer lip and of an inner lip. The packing is squeezed into position by a shouldered gland or pressure ring which is forced with its inner and thicker part against the packing by a cap nut, which is screwed on to the body *A*, the cap nut being engaged with the shoulder of the ring. This screwing is effected by means of oblique handles solid with the nut. The fact that the packing is not squeezed against an abutment surface substantially perpendicular to the axis of the piston, as is the usual practice, but has its inner extremity free, results in diminishing considerably the risk of crushing the packing. Moreover, the truncated conical form of the external surface of the packing and of the internal surface of the stuffing-box body permits of the taking up of the wear of the packing as it is produced.—*January* 15, 1958.

## MACHINE TOOLS

**789,242.** July 27, 1955.—CUTTING OF INVOLUTE GEARS, Associated Electrical Industries, Ltd., Crown House, Aldwych, London, W.C.2. (*Inventor: Alfred William Crook.*)

The invention has important application in methods of producing helical gears from cylindrical blanks by means of plane sided rotary cutters which are in ultimate contact with the formed gear along generating lines of involute helicoid surfaces, these lines being lines of contact between the gear and a gear with which it is designed to mate, and also in methods of producing gears by means of rotary cutters with formed cutting profiles. Referring to the drawing, a cylindrical blank *A* is coupled to a worm wheel *B*, which, in turn, is driven from a motor *C* via a gearbox *D* and worm *E*. The gearbox is also coupled to lead screw *F*. A carriage *G* is connected to the lead screw by a split nut similar to that in the apron of a lathe. Mounted on the carriage is a rotating cutter *H* which is movable along slide *J* so as to be brought into engagement with blank *A* and cut one side of a helical tooth. Another similar cutter, not shown, is also mounted on the slide *J* to cut the other side of the tooth. In the example described, the apparatus is adapted to cut a helix of 30 deg. and this may be obtained by suitable ratios in gearbox *D* coupled with a given pitch on lead screw *F*. To satisfy the condition for correct indexing, means must be provided to ensure that after the split nut has once been engaged for a cutting stroke, it is only re-engaged at positions such that the distance between the carriage *G* and a notional nut in continuous engagement with the lead screw *F* differs from this distance at first engagement by an integral number of axial pitches. To this end, a rotating pointer *K* is provided geared to the lead screw and a pointer *L* is provided fixed to carriage *G*. Thus, if the nut is engaged only when the



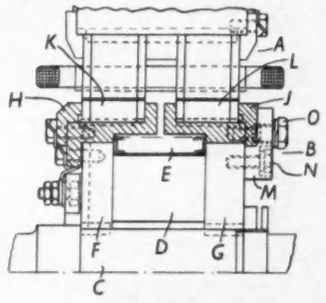

No. 789,242

pointer *K* coincides with pointer *L*, the operation is as follows. The gear blank *A* is continuously rotated and the machine starts with the carriage *G* at the bottom. First, the split nut is engaged when the indicator *K* comes to zero and then the slide *J* is thrust forward on the carriage to bring the cutters into their operating position. The cutters, carried upwards by the carriage, cut the right-hand surface of one tooth space and the left-hand surface of another. At the end of the stroke the split nut is disengaged, the cutters are retracted and the carriage *G* is returned to its starting position. When the indicator *K* is again at zero, the operation is repeated.—*January* 15, 1958.

## ELECTRICAL ENGINEERING

**786,485.** May 4, 1954.—PERMANENT MAGNET-EXCITED GENERATORS, The British Thomson-Houston Company Ltd., Crown House, Aldwych, London, W.C.2. (*Inventor: Kenneth Francis Raby.*)

The invention relates to generators including high frequency generators, which are permanent-magnet-excited, and aims at providing a comparatively simple yet effective means for adjusting their terminal voltages. The machine shown in the drawing comprises a stator *A* which can be of conventional design and forms no part of the invention, and a rotor *B* mounted on a shaft *C* by any convenient means. The magnetic flux is provided by an annular permanent magnet *D* which is axially magnetised




No. 786,485

and may carry a magnetising winding *E* for use during manufacture, or subsequently, for remagnetising the permanent magnet. The magnet is held between end rings *F* and *G*, which rotate with the shaft *C*, to four supports to which are secured sleeves *H* and *J* holding laminated core rings *K* and *L*. The end rings and sleeves are of magnetically permeable material, such as mild steel, and the laminated core rings have toothed outer surfaces as usual. The means for fastening the sleeve *J* to the end ring *G* is such as to allow a slight relative rotation. It comprises a clamping arrangement formed by a connecting ring *M* fixed to the end ring *G* by screws *N* while the sleeve *J* is held in position by clamping screws *O* which extend through curved slots of the ring *M*, the angular extension of the slots corresponding to the degree of adjustment which is required. The sleeve *H* at the other end of the rotor can be secured to the end ring *F*. The setting by angular adjustment can be made when the machine is tested in manufacture, and later when the machine is in service. Furthermore, whenever it is required to modify the open circuit voltage, for maintaining a rated voltage with an increased load for instance, a suitable adjustment is possible by varying the relative angular displacement of the two toothed portions. Modifications are possible without departure from the invention.—*November* 20, 1957.

# Forthcoming Engagements

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

### ANTIQUARIAN HOROLOGICAL SOCIETY

*Fri., Feb.* 14.—Lecture Theatre, Science Museum, Kensington, S.W.7, "Clock Escapements," W. J. Gazeley, 7 p.m.

### ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

*To-day, Feb.* 7.—BRISTOL AND WEST OF ENGLAND BRANCH: Grand Hotel, Broad Street, Bristol, "The Diesel Generator as a Composite Heat and Power Generator," F. J. Buxton, 8 p.m. ★ LIVERPOOL AND DISTRICT BRANCH: Liverpool Engineering Society, 9, The Temple, 24, Dale Street, Liverpool, 2, "X-Ray Tubes and their Problems," L. C. Maple, 7.30 p.m. ★ STOKE AND CREWE BRANCH: Grand Hotel, Hanley, Stoke, "Power Supply and Distribution in North Staffs," C. C. Pimble, 7.30 p.m.

*Mon., Feb.* 10.—NORTH WEST LONDON BRANCH: Century Hotel, Forty Avenue, Wembley Park, "Industrial Welfare," J. C. Graham, 8.15 p.m.

*Tues., Feb.* 11.—PORTSMOUTH BRANCH: Wiltshire Lamb Hotel, Portsmouth, Film, "1957 Electrical Engineers' Exhibition," 7.30 p.m. ★ YORK BRANCH: Royal Station Hotel, York, "Heenan and Froude Electronically Controlled Variable-Speed Drive Equipments," R. H. Stannard, 7.30 p.m.

*Wed., Feb.* 12.—BIRMINGHAM BRANCH: Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham, 2, "Electrostatic Precipitation and its Application in Industry," 7.30 p.m. ★ BRADFORD BRANCH: Midland Hotel, Bradford, Films on "Calder Hall Construction," 7.30 p.m. ★ LUTON BRANCH: Luton and Dunstable Chamber of Commerce, George Street West, Luton, "Thermal Storage and Floor Heating," E. C. Green, 8 p.m.

*Thurs., Feb.* 13.—SOUTH WEST LONDON BRANCH: Prince of Wales Hotel, Wimbledon, London, S.W.19, "Supply and Distribution of Electricity," L. H. Welch, 7.45 p.m.

*Sat., Feb.* 15.—OXFORD, READING AND DISTRICTS BRANCH: Collier Lecture Room, Regent's Park College, Pusey Street, Oxford, "Lighting Specification, Design and Planning," 7 p.m.

### BRITISH INSTITUTION OF RADIO ENGINEERS

*Wed., Feb.* 12.—WEST MIDLANDS SECTION: Wolverhampton Technical College, Wulfruna Street, Wolverhampton, "Industrial Applications of Radio Isotopes," R. F. Armitage, 7.15 p.m. ★ NORTH EASTERN SECTION: Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle upon Tyne, Short Papers by Students, 6 p.m.

### INCORPORATED PLANT ENGINEERS

*Mon., Feb.* 10.—DUNDEE BRANCH: Mathers Hotel, Dundee, "Industrial Drying Equipment and Cloth Finishing Machinery," R. S. Laurie, 7.30 p.m.

*Tues., Feb.* 11.—MANCHESTER BRANCH: Engineers' Club, Albert Square, Manchester, "Modern Trends of Lighting in Industry," A. Wilcock, 7.15 p.m.

*Wed., Feb.* 12.—EAST MIDLANDS BRANCH: Sherwood Room, County Hotel, Theatre Square, Nottingham, "The New Clifton Bridge," R. M. Finch, 7 p.m. ★ WESTERN BRANCH: Grand Hotel, Bristol, "Oil Firing," G. J. Gollin, 7.15 p.m.

*Thurs., Feb.* 13.—MERSEYSIDE AND NORTH WALES BRANCH: Exchange Hotel, Liverpool, "Non-Ferrous Welding," E. A. Foreman, 7.15 p.m. ★ NORTH EAST BRANCH: Roadway House, Oxford Street, Newcastle upon Tyne, "The Free Piston Engine Compressor," R. A. Evans, 7 p.m.

### INSTITUTE OF BRITISH FOUNDRYMEN

*Tues., Feb.* 11.—SLOUGH SECTION: Lecture Theatre, High Duty Alloys, Ltd., Slough, "Feeding Aids to Castings," A. L. Logan, 7.30 p.m.

### INSTITUTE OF FUEL

*To-day, Feb.* 7.—SOUTH WALES SECTION: South Wales Institute of Engineers, Park Place, Cardiff, "Some Aspects of Fuel Efficiency in Modern Blast-Furnace Practice," K. C. Sharp, 6 p.m.

### INSTITUTE OF MARINE ENGINEERS

*Mon., Feb.* 10.—WEST OF ENGLAND SECTION: Grand Hotel, Bristol, "Some Notes on the Propulsion of Tug Boats," G. S. Selman, 7.30 p.m.

*Wed., Feb.* 12.—SCOTTISH SECTION: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, Annual General Meeting, "Nuclear Steam Propulsion for Merchant Ships," W. R. Wootton, 7.30 p.m.

*Thurs., Feb.* 13.—WEST MIDLANDS SECTION: Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham, Annual General Meeting, "Developments in Marine Electrical Installations, with Particular Reference to A.C. Supply," A. N. Savage, 6.30 p.m. ★ NORTH EAST COAST SECTION: Stephenson Building, King's College, Claremont Road, Newcastle upon Tyne, Annual General Meeting, 6.15 p.m.

*Mon., Feb.* 17.—SOUTHERN JOINT BRANCH: Portsmouth College of Technology, Portsmouth, with the Institution of Naval Architects, "Nuclear Power for Ship Propulsion," S. L. Smith, 7.30 p.m.

### INSTITUTE OF METALS

*Mon., Feb.* 10.—SCOTTISH LOCAL SECTION: Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.2, "Recent Developments in the Foundry," D. V. Atterton, 6.30 p.m.

### INSTITUTE OF ROAD TRANSPORT ENGINEERS

*Mon., Feb.* 10.—EAST REGIONAL CENTRE: Council Chamber, Houldsworth Hall, 90, Deansgate, Manchester, "Battery Manufacture and Maintenance," 7.30 p.m.

*Tues., Feb.* 11.—MIDLANDS CENTRE: Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham, "The Maintenance of Commercial and Passenger Vehicles," W. P. James, 7.30 p.m.

*Wed., Feb.* 12.—SOUTHERN CENTRE: Royal Star Hotel, Maidstone, Kent, "The Free Piston Gasifyer, with Special Reference to Vehicle Applications," 7.30 p.m.

*Fri., Feb.* 14.—SOUTH WALES CENTRE: South Wales Institute of Engineers, Park Place, Cardiff, "Various Trends in Machining and Inspection Methods Concerning the Manufacture of Heavy Commercial Vehicles," R. P. Chilton, 7 p.m. ★ WESTERN CENTRE: Rougement Hotel, Exeter, "Gas Turbines and their Application to Road Transport," A. Enticknap, 7 p.m.

*Mon., Feb.* 17.—SCOTTISH CENTRE: North British Hotel, Edinburgh, "The Adaption of Commercial Vehicles for Use in a Special Purpose Mixed Fleet," R. H. R. Hacker, 7.30 p.m.

### INSTITUTION OF CIVIL ENGINEERS

*Tues., Feb.* 11.—Great George Street, Westminster, London, S.W.1, "Design and Construction of Concrete Roads Overseas," A. R. Collins and D. R. Sharp, 5.30 p.m.

### INSTITUTION OF ELECTRICAL ENGINEERS

*To-day, Feb.* 7.—HATFIELD DISTRICT BRANCH: Technical College, Hatfield, "Colour Television," P. C. Kidd, 7 p.m.

*Mon., Feb.* 10.—LONDON BRANCH: Savoy Place, London, W.C.2, Discussion on "The Herbert Report and the 1957 Act," opened by E. R. Wilkinson, 5.30 p.m. ★ MALVERN AND DISTRICT GRADUATE MEETING: Midland Electricity Board Sports Club, Worcester, "Thermal Rating of Transformers," H. W. Harden, 7.30 p.m. ★ NORTH EASTERN CENTRE: Neville Hall, Newcastle upon Tyne, "Supply-Voltage and Current Variations Produced by a 60-ton, Three-Phase, Electric Arc Furnace," B. C. Robinson and A. I. Winder, 6.15 p.m. ★ SOUTH MIDLAND SUPPLY AND UTILIZATION GROUP: College of Technology, Birmingham, "British Columbia–Vancouver Island 138kV Submarine Power Cable," T. Ingledow, R. M. Fairfield, E. L. Davey, K. S. Brazier and J. N. Gibson, 6 p.m. ★ SOUTHERN CENTRE: Guildhall, Southampton, Faraday Lecture, "The Electrification of the British Railways," by the late G. H. Fletcher, delivered by R. Ledger, 2.30 p.m. and 6.30 p.m. ★ WESTERN CENTRE: South Wales Institute of Engineers, Cardiff, "The Generation of Electricity in the London Area," H. V. Pugh, 6 p.m.

*Tues., Feb.* 11.—LONDON GRADUATE AND STUDENT SECTION: Assembly Hall, 3 (Tels.) Training Bn., R.E.M.E., Arborfield, Berks, "'Sputnik'—The Tracking of the Russian Earth Satellite," D. L. Cooper-Jones, 7 p.m. ★ NORTH WESTERN UTILIZATION GROUP: Engineers' Club, Albert Square, Manchester, Joint Meeting with Radio and Telecommunication Group, "Electric Control of Stage and Television Lighting," F. P. Bentham, 6.15 p.m. ★ NORTHERN IRELAND CENTRE: Civil Engineering Department, David Keir Building, Queen's University, Belfast, "Electricity in Modern Commercial Horticulture," C. A. Cameron Brown and A. W. Gray, 6.30 p.m. ★ SOUTH WEST SCOTLAND SUB-CENTRE: Royal College of Science and Technology, George Street, Glasgow, C.1, "The Relation Between Picture Size, Viewing Distance and Picture Quality, with Special Reference to Colour Television and to Spot-Wobble Techniques," L. C. Jesty, 7 p.m. ★ RUGBY SUB-CENTRE: Technical College, Rugby, "The Development of Variable-Speed High-Power Drives for Large Wind Tunnels," and "A Variable-Frequency Power Installation for Large Wind-Tunnel Drives," P. McKearney, L. S. Drake and E. G. Mallalieu, 6.30 p.m.

*Wed., Feb.* 12.—LONDON BRANCH: Central Hall, Westminster, London, S.W.1, Faraday Lecture, "The Electrification of the British Railways," by the late G. H. Fletcher, delivered by R. Ledger, 6 p.m. ★ LONDON GRADUATE AND STUDENT SECTION: Visit to Lots Road Generating Station, Chelsea, 2.30 p.m. ★ NORTH WESTERN RADIO AND TELECOMMUNICATION GROUP: Engineers' Club, 17, Albert Square, Manchester, "The Use of Transistors in Radio and Television," A. J. Biggs and E. Wolfendale, 6.45 p.m. ★ NORTH LANCASHIRE SUB-CENTRE N.W.E.B., Demonstration Theatre, North Road, Lancaster, "Choice of Insulation and Surge Protection of Overhead Transmission Lines of 33kV and Above," A. Morris Thomas and D. F. Oakeshott, 7.15 p.m. ★ SOUTH EAST SCOTLAND SUB-CENTRE: Carlton Hotel, North Bridge, Edinburgh, "The Relation Between Picture Size, Viewing Distance and Picture Quality, with Special Reference to Colour Television and to Spot-Wobble Techniques," L. C. Jesty, 7 p.m. ★ OXFORD DISTRICT BRANCH: Southern Electricity Board, 37, George Street, Oxford, "Developing Pattern of Atomic Generation," I. Everson, 7 p.m.

*Thurs., Feb.* 13.—UTILIZATION AND SUPPLY SECTIONS: Savoy Place, London, W.C.2, "Supply-Voltage and Current Variations Produced by a 60-Ton, Three-Phase Electric Arc Furnace," B. C. Robinson, 5.30 p.m. ★ EAST MIDLAND CENTRE: George Hotel, Kettering, "275kV Transmission Lines," J. D. Pierce, 7.30 p.m. ★ NORTH SCOTLAND SUB-CENTRE: Electrical Engineering Department, Queen's College, Dundee, "Some Recent Developments in Power Transformer Manufacture," A. C. Franklin, 7 p.m. ★ WEST WALES (SWANSEA) SUB-CENTRE: Conference Rooms, South Wales Electricity Board Showrooms, The Kingsway, Swansea, "Electrolytic Tinning," J. Nelsey, 6 p.m.

*Fri., Feb.* 14.—NORTH EASTERN GRADUATE AND STUDENT SECTION: Grey Hall, King's College, Newcastle upon Tyne, "Nuclear Power Stations," A. St. John MacKeller, 6.30 p.m. ★ NORTH SCOTLAND SUB-CENTRE: Robert Gordon's Technical College, Aberdeen, "Some Recent Developments in Power Transformer Manufacture," A. C. Franklin, 7.30 p.m.

*Mon., Feb.* 17.—MERSEY AND N. WALES CENTRE: Royal Institution, Colquitt Street, Liverpool, Discussion on the Report "The Supply and Training of Teachers for Technical Colleges," introduced by Willis Jackson, 6.30 p.m. ★ NORTH EASTERN RADIO AND MEASUREMENTS GROUP: King's College, Newcastle upon Tyne, "The Measurement of High Voltages with Indicating or Recording Instruments," G. W. Bowdler, 6.15 p.m. ★ WESTERN SUPPLY GROUP: The University, Large Lecture Theatre, Engineering Department, University Walk, Bristol, "Mechanical Strength of Power Transformers in Service," E. T. Norris, 6 p.m.

### INSTITUTION OF ENGINEERING DESIGNERS

*Mon., Feb.* 10.—NORTH EAST BRANCH: Northern Architectural Association Hall, 6, Higham Place, Newcastle upon Tyne, "A Review of Modern Techniques and Materials for the Designer," J. Christie and F. A. Roberts, 7.15 p.m.

### INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND

*Tues., Feb.* 11.—39, Elmbank Crescent, Glasgow, C.2, "Welded Ship Construction—Records of Common Fractures and their Causes," H. R. Gibbs and G. M. Boyd, 6.30 p.m.

### INSTITUTION OF HIGHWAY ENGINEERS

*To-day, Feb.* 7.—Institution of Structural Engineers, 11, Upper Belgrave Street, London, S.W.1, Joint Meeting with Roads Group, Society of Chemical Industry, Papers on "Planting and Control of Road Verges," E. K. Woodford, R. C. B. Gardner and Mrs. M. W. Spitta, 5.30 p.m.

### INSTITUTION OF LOCOMOTIVE ENGINEERS

*Wed., Feb.* 12.—Institution of Mechanical Engineers, 1, Birdcage Walk, London, S.W.1, General Meeting, "Experience with the Steel Fireboxes of the Southern Region 'Pacific' Locomotives," M. G. Burrows and A. L. Wallace, 5.30 p.m.

### INSTITUTION OF MECHANICAL ENGINEERS

*To-day, Feb.* 7.—SCOTTISH BRANCH: Robert Gordon's College, Aberdeen, "Machinery in Cross-Channel Passenger Ships," E. L. Denny, 7.30 p.m.

*Tues., Feb.* 11.—GENERAL MEETING, AUTOMOBILE DIVISION: 1, Birdcage Walk, Westminster, London, S.W.1, "Air Suspension for Road Vehicles," J. Sainsbury, 6 p.m. ★ EASTERN BRANCH: Assembly House, Norwich, "The Jaguar Engine," W. M. Heynes, 7.30 p.m. ★ EAST MIDLANDS GRADUATES' SECTION: Technical College, Newark, Film Show, 7.15 p.m.

*Wed., Feb.* 12.—EAST MIDLANDS BRANCH: Aveling-Barford, Ltd., Grantham, "The Rival Rail Traction Systems," J. W. Caldwell, 7.30 p.m. ★ N.W. BRANCH: Liverpool Engineering Society, 24, Dale Street, Liverpool, "Machinery in Cross-Channel Passenger Ships," E. L. Denny, 6 p.m. ★ LUTON A.D. CENTRE: Town Hall, Luton, "Corrosion Prevention in Automobile Bodies," T. P. Hoar, 7.30 p.m. ★ SOUTHERN GRADUATES' SECTION: Technical College, Southampton, "Some Experiences of a Lubrication Engineer," J. A. Ariey, Film Show, 7.30 p.m.

*Thurs., Feb.* 13.—N.W., A.D., CENTRE: Engineers' Club, Albert Square, Manchester, "Some Experiments with Internal Combustion Engines," R. C. Cross, 7.15 p.m.

*Fri., Feb.* 14.—GENERAL MEETING, APPLIED MECHANICS GROUP: 1, Birdcage Walk, Westminster, London, S.W.1, "The Application of Servo-Mechanism Analysis to Fuel Control Problems," O. N. Lawrence and R. D. Powell, 6 p.m. ★ N.E. GRADUATES' SECTION: Grey Hall, King's College, Newcastle upon Tyne, "Nuclear Power Stations," A. St. John MacKeller, 6.30 p.m.

### INSTITUTION OF NAVAL ARCHITECTS

*Mon., Feb.* 17.—SOUTHERN JOINT BRANCH WITH INSTITUTE OF MARINE ENGINEERS: College of Technology, Anglesea Road, Portsmouth, "Nuclear Power for Ships," S. Livingston Smith, 7.30 p.m.

### INSTITUTION OF PRODUCTION ENGINEERS

*Mon., Feb.* 10.—SHEFFIELD SECTION: Grand Hotel, Sheffield "Automation in the Steel Industry," R. H. Baulk, 6.30 p.m.

*Tues., Feb.* 11.—DONCASTER SECTION: Danum Hotel, Doncaster, "We Build the Jig Mill," R. C. Fenton, 7.15 p.m. ★ BIRMINGHAM GRADUATE SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, "Metal Spraying," W. E. Stantion, 7 p.m. ★ MANCHESTER GRADUATE SECTION: College of Science and Technology, Sackville Street, Manchester, "Industrial Electronic Instrumentation," R. B. Smith, 7.15 p.m. ★ OXFORD SECTION: Randolph Hotel, Oxford, "Technical Training and Professional Status," The Rt. Hon. The Earl of Halsbury, 7.30 p.m.

*Wed., Feb.* 12.—EASTERN REGION: Assembly House, Theatre Street, Norwich, "Spark Machining of Dies," E. Foster, 7.30 p.m. ★ LIVERPOOL SECTION: Exchange Hotel, Tithebarn Street, Liverpool, 2, "The Pattern of Productivity Control," F. B. Schofield, 7.30 p.m. ★ LIVERPOOL GRADUATE SECTION: Stork Hotel, Queen's Square, Liverpool, "Fuel Efficiency," 7.30 p.m. ★ SOUTH ESSEX SECTION: Ilford Club, 21A, Balfour Road, Ilford, "Automatic Railway Signalling in Relation to Railway Electrification," G. W. Bentall, 7.30 p.m. ★ WESTERN GRADUATE SECTION: Royal Hotel, College Green, Bristol, 1, "High-Frequency Heating," W. Rupp, 7.30 p.m.

*Thurs., Feb.* 13.—LEICESTER SECTION: Grand Hotel, Leicester, Annual General Meeting, Address by L. S. Pitteway, 7 p.m. ★ ROCHESTER SECTION: Sun Hotel, Chatham, "Unconventional Tooling," S. E. Kirk, 7.30 p.m. ★ CORNWALL SECTION: Technical College, Treverson Pool, Redruth, Cornwall, "Production Engineering Techniques," 7 p.m.

*Fri., Feb.* 14.—IPSWICH AND COLCHESTER SECTION: Golden Lion Hotel, Cornhill, Ipswich, "Designing for Production," A. P. Peat, 7.30 p.m. ★ SWANSEA SECTION: Central Library, Alexandra Road, Swansea, "The Importance of Production Engineering," L. E. Bunnett, 7.30 p.m.

*Mon., Feb.* 17.—SHEFFIELD GRADUATE SECTION: Beaston, Clark and Co., Ltd., Rotherham, "Glass Making," 6.30 p.m. ★ COVENTRY SECTION: Craven Arms, High Street, Coventry, "Spark Erosion," Herr Ullmann, 7.15 p.m. ★ MANCHESTER SECTION: College of Science and Technology, Sackville Street, Manchester, "Metal Cutting Lubricants and Coolants," D. A. Wight, 7.15 p.m.

### INSTITUTION OF THE RUBBER INDUSTRY

*Mon., Feb.* 10.—MANCHESTER SECTION: Newton Heath Technical College, Manchester, "Some Practical Aspects of Latex Foam Manufacture," N. Grimshaw, 6 p.m. ★ MIDLAND SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, "Coating for the Rubber Industry," W. H. Oakley, 6.45 p.m. ★ SOUTH WALES AND MONMOUTHSHIRE SECTION: Wyndham Hotel, Bridgend, "Butadiene and its Co-Polymers," N. D. MacLeod, 7.30 p.m.

### INSTITUTION OF STRUCTURAL ENGINEERS

*To-day, Feb.* 7.—MIDLAND COUNTIES GRADUATES' AND STUDENTS' SECTION: Birmingham Exchange and Engineering Centre, Stephenson Place, Birmingham, "Prestressing and the Systems in Common Use To-day," J. E. C. Farebrother, 6.30 p.m. ★ WESTERN COUNTIES BRANCH: Small Lecture Theatre, University Engineering Laboratories, Bristol, "Recent Developments in Timber Engineering," H. Tottenham, 6 p.m.

*Wed., Feb.* 12.—LANCASHIRE AND CHESHIRE BRANCH: College of Science and Technology, Manchester, "The Use of the Electronic Digital in Structural Calculations," D. M. Brotton, 6.30 p.m.

*Thurs., Feb.* 13.—11, Upper Belgrave Street, London, S.W.1, "Web Buckling and the Design of Web Plates," K. C. Rockey, 5.55 p.m.

### LIVERPOOL METALLURGICAL SOCIETY

*Thurs., Feb.* 13.—Liverpool Engineering Society, The Temple, Dale Street, Liverpool, "Wear in Cast Iron," H. T. Angus, 7 p.m.

### MANCHESTER ASSOCIATION OF ENGINEERS

*Fri., Feb.* 14.—Engineers' Club, Albert Square, Manchester, "Models in Engineering," J. A. L. Mathieson, 6.45 p.m.

### NEWCOMEN SOCIETY

*Wed., Feb.* 12.—Science Museum, London, S.W.7, "Land Measurement in the Sixteenth Century," D. Chilton, 5.30 p.m.

### NORTH EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS

*To-day, Feb.* 7.—Lecture Theatre, Mining Institute, Newcastle upon Tyne, "Tip Clearance and Shrouding Effects in Axial Flow Compressors," R. C. Turner and J. L. Jefferson, 6.15 p.m.

### PLASTICS INSTITUTE

*Mon., Feb.* 10.—LONDON AND DISTRICT SECTION: Borough Polytechnic, Borough Road, London, S.E.1, "Injection Moulding Machinery," E. Gaspar, 6.30 p.m.

### REINFORCED CONCRETE ASSOCIATION

*Wed., Feb.* 12.—11, Upper Belgrave Street, London, S.W.1, "Grouted Concrete Construction," S. Champion and L. Truman Davies, 6 p.m.

### ROYAL AERONAUTICAL SOCIETY

*Thurs., Feb.* 13.—MAIN LECTURE: Institution of Mechanical Engineers, 1, Birdcage Walk, Westminster, London, S.W.1, "The Application of the Theory of Stability in Structural Design," H. L. Cox 6 p.m.

### SHEFFIELD METALLURGICAL ASSOCIATION

*Tues., Feb.* 11.—B.I.S.R.A., Hoyle Street, Sheffield, "Developments in the Use of Refractories at the Steel Division of the Steel Company of Wales," G. M. Workman, 7 p.m.

*Mon., Feb.* 17.—Engineering Lecture Theatre, The University, St. George's Square, Sheffield, "Low Carbon Bainitic Steels," K. J. Irvine, 7.30 p.m.

### SOCIETY OF CHEMICAL INDUSTRY

*To-day, Feb.* 7.—ROAD AND BUILDING MATERIALS GROUP: Institution of Structural Engineers, 11, Upper Belgrave Street, London, S.W.1, Joint Meeting with Institution of Highway Engineers, "Planting and Control of Road Verges," E. K. Woodford, R. C. B. Gardner and Mrs. M. W. Spitta, 5.30 p.m.

*Mon., Feb.* 17.—14, Belgrave Square, London, S.W.1, "Protection of Spraying and Dusting Equipment," 6 p.m.

### WEST OF SCOTLAND IRON AND STEEL INSTITUTE

*Fri., Feb.* 14.—39, Elmbank Crescent, Glasgow, C.2, "High-Temperature Testing," J. Glen, 6.45 p.m.

# SPRAY NOZZLE

**NON-CLOGGING INVOLUTE TYPE**

¼" to 3" Dia. Inlet.

Capacities 2½ to 12,000 G.P.H.

For Water Cooling, Gas Washing, Dust Laying and other purposes.

## LEDWARD & BECKETT LTD

PARLIAMENT MANSIONS • ABBEY ORCHARD ST.

PHONE: ABBEY 5429 **LONDON, S.W.1.**

# Design Capacity Available

We have teams available to undertake design detailing and development in the following fields:

*The conception, design and development of* **"BLUEBIRD"** *was a special project undertaken by*

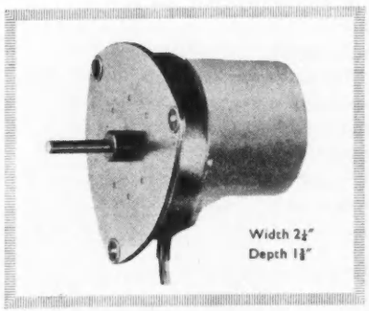
- MECHANICAL ENGINEERING
- AERONAUTICAL ENGINEERING
- SPECIAL MACHINES & PROJECTS
- SERVO MECHANISMS & AUTOMATION
- MECHANICAL HANDLING
- PLANT LAYOUT
- PRODUCTION TOOLING
- CHEMICAL PLANT
- STRUCTURE & REINFORCED CONCRETE ETC.

**NORRIS BROTHERS Ltd.**
**53, Victoria Street, S.W.1.**
Tel: ABBey 6132

62, CHURCH RD., BURGESS HILL, SUSSEX
Tel: BURgess Hill 85678

# THIS is the motor

FOR SEQUENCE SWITCHING, CHART RECORDERS, PROCESS CONTROLLERS, INSTRUMENTATION, AUTO-LUBRICATION, etc.




- ★ SELF STARTING
- ★ CONSTANT SPEED
- ★ YEARS OF RELIABLE SERVICE
- ★ WIDE VARIETY OF SPEEDS
- ★ COMPETITIVE PRICE

Sintered bronze rotor bearings ensure long life. Power consumed 1–2 watts. Write or telephone now for full details of this compact, totally enclosed LIGHT DUTY Motor Unit.

## SMITHS

**CONSTANT SPEED MOTORS**

CONTRACTS BRANCH, SMITHS CLOCKS & WATCHES LTD., 179 GREAT PORTLAND STREET, LONDON, W.1. LANgham 5811

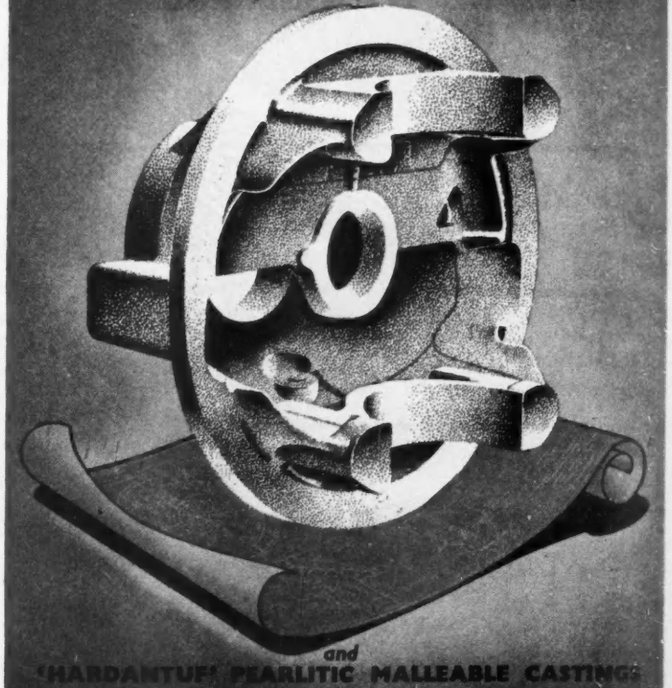
*A Division of S. Smith & Sons (England) Ltd.*

# SHOTTON

for

BETTER BLACKHEART MALLEABLE IRON CASTINGS

*Backed by 60 years experience & technique*



and

'HARDANTUF' PEARLITIC MALLEABLE CASTINGS

SHOTTON BROS. LTD., OLDBURY Nr. BIRMINGHAM. Tel: BROadwell 1631

We are now booking capacity for our New Modern Foundry at Halesowen.

ACRATORK Regd.

PRECISION TORQUE SPANNERS

- Control torque application automatically
- Make overloading impossible
- Do not depend on the vision, care or skill of the operator for their accuracy
- Are unaffected by side loads
- Give precision results with unskilled labour
- Retain their accuracy for long periods of continuous use without attention

Sixteen models provide for all loads up to 850 lbs./ft.



L3 Test Rig

Also Hydraulic Torque Generators for loads up to 3,000 lbs./ft.

World Distributors

**CORY BROTHERS & CO. LTD**

DEPT. E., CORYS' BUILDINGS, CARDIFF Telephone: Cardiff 31141

**Forgings**

IN IRON & STEEL UP TO 1½ CWTS.

GEORGE MILLS (ENGINEERS) LTD. Established 1920

214-218 RAVENSCROFT RD., BECKENHAM, KENT Telephone: SYDenham 5233

A.I.D. APPROVED

A.R.B. APPROVED

PROTOTYPES AND SPECIAL PURPOSE MACHINES

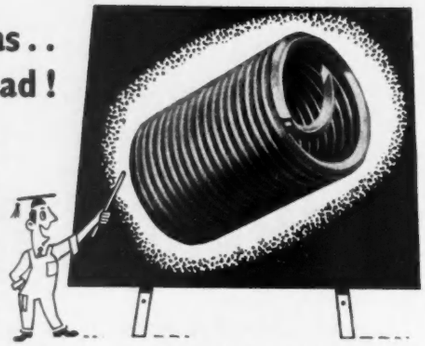
HEAVY AND "AWKWARD" MACHINING & GRINDING

REPAIRS & SALVAGE BY METAL DEPOSITION IN STELLITE, CHROME, NICKEL Etc.

WELDING FABRICATING PROFILE FLAME CUTTING AND GENERAL PRESSWORK

**It's as simple as.. Fit your thread!**

Hard tough threads in soft materials—new threads for old in damaged components. Used and approved by the Aircraft Industry—designed for use in soft metal components, wood or plastics. Simple to use, remains permanently in place. Full range of standard sizes in B.S.W.: B.S.F.: B.S.P.: B.A. U.N.F.: U.N.C. and Metric thread forms.

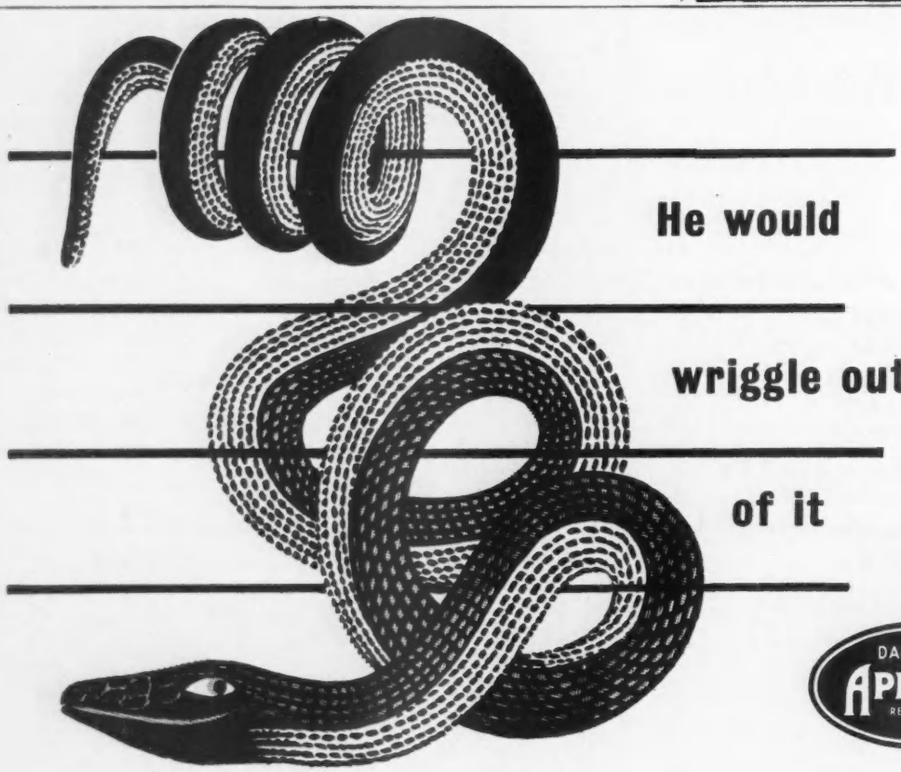


**Cross** WIRE THREAD INSERTS

CROSS MANUFACTURING CO. (1938) LTD. · BATH·SOMERSET.

Tel: Combe Down 2355-8 Grams: Circle, Bath.

SPECIALISTS IN THE MANUFACTURE OF JET ENGINE LABYRINTHS, CIRCLIPS, SPRING WASHERS, SPRINGS, ETC.



**He would wriggle out of it**

Someone must take the blame though—after all, corrosion in the boilers indicates an expensive blunder on somebody's part.

How easy to have specified "Apexior" at the beginning! "Apexior Number 1" positively prevents corrosion in boilers and steam-raising plant, where wet temperatures between 175° and 1000° F. are encountered. Absolute protection for at least 12 months is assured with an initial double coating, mechanically or brush applied. Thereafter one coat is sufficient. Scale does not accumulate so much nor adhere so firmly to Apexiorised surfaces. For over 50 years, leading manufacturers of boilers and all steam-raising plant have relied on "Apexior" to fight their corrosion battles—why not follow their example?

*Send for your copy of the "Apexior Manual"*

DAMPNEY'S APEXIOR REGISTERED

**BRITISH PAINTS LIMITED • Apexior Division**

PORTLAND ROAD · NEWCASTLE UPON TYNE, 2

CREWE HOUSE, CURZON STREET, LONDON, W.1

SYDNEY · ADELAIDE · TORONTO · DURBAN · CAPE TOWN · CALCUTTA · TRINIDAD · NEW YORK · ARKLOW

OUR WORLD-WIDE SERVICE IS AT YOUR DISPOSAL FOR THE ASKING

**"Apexior Number 1" prevents corrosion in steam-raising plant**

*But use "Apexior Number 3" for cold-wet surfaces up to 125°F.*

BPL/A.33

# Built to make CATALYSTS

This battery of catalyst pelleting machines is in ICI's Clitheroe factory where extensions and modernisation were completed in 1957 to make it the most modern plant of its kind in the world. Simon Handling Engineers were main contractors for the installation which caters not only for ICI's own needs but also for the export of catalysts by them all over the world. The extensions include machinery conveyors and instrument control gear and have doubled output. During erection, close co-operation between ICI and Simon allowed production to continue without interruption. Today the Clitheroe factory is operating round the clock for seven days a week to make essential products for many important industries including those manufacturing fertilisers, oil products, petroleum chemicals, plastics and man-made fibres. Plants designed and built by Simon are handling a wide variety of materials all over the world.

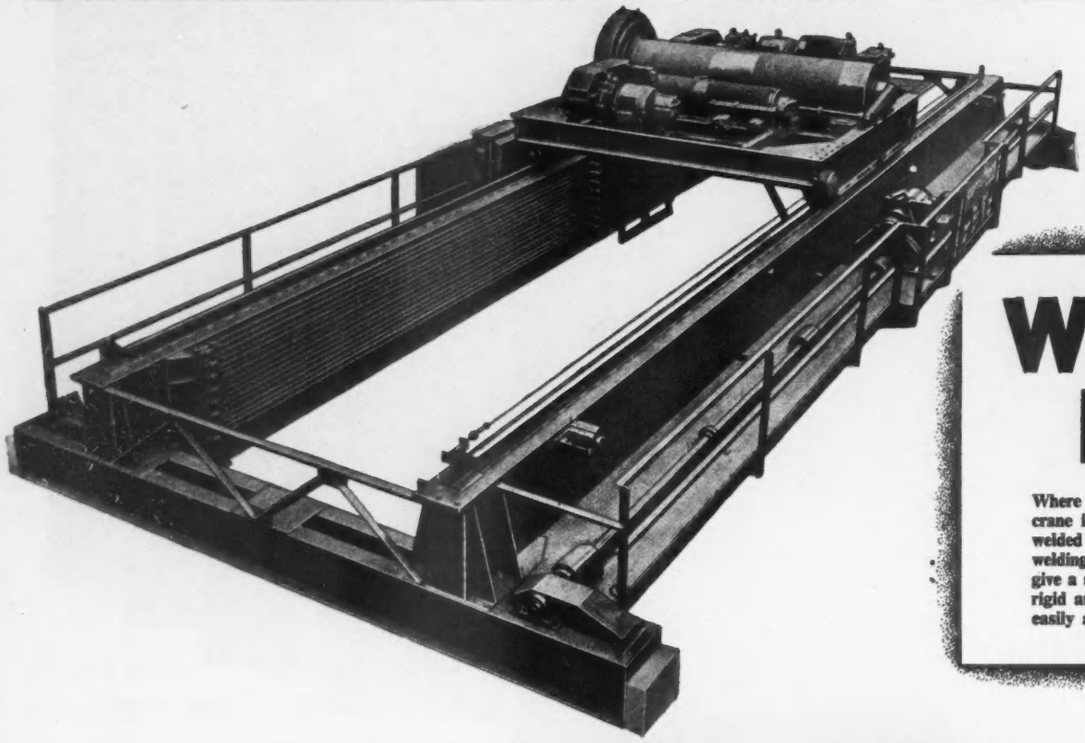
*Simon Handling Engineers Ltd.*

SIMON ENGINEERING GROUP

STOCKPORT, ENGLAND

*Telephone: Gatley* 3621 (16 *lines*) *Telex:* 66–287 *Telegrams: Reform Manchester Telex*

# In overhead travelling cranes maximum allowable wheel loads should determine the choice of these two girder types . . . .



## WELDED BOX

Where the wheel loading of an overhead crane is not important Carruthers welded box plate girders, with modern welding technique, can be designed to give a structure, compact, accessible, rigid and strong, with smooth surfaces easily and quickly painted.

## WELDED TUBE

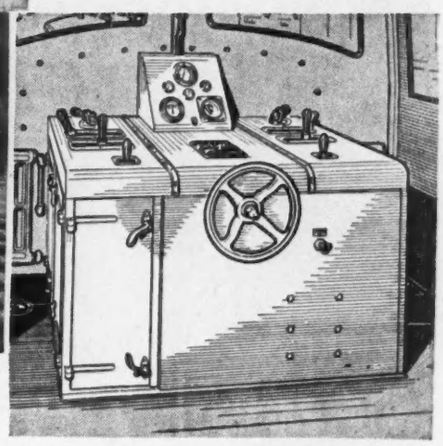
Where the wheel loading is an important factor, Carruthers welded steel tube construction is recommended because its lightness and strength can reduce maximum wheel loadings by as much as 40%.

**carruthers**

J. H. CARRUTHERS & CO. LTD., 27, HAMILTON ST., GLASGOW, S.2 London Office: Abford House, Wilton Rd., Victoria, S.W.1

*for simplicity... of control...*

The controls of the Peckett Diesel Locomotive are easy to handle—no special manipulation of throttle or clutch is required for gear changing.



**PECKETT** *diesels*

The various control levers have been carefully grouped for maximum convenience and are duplicated on either side of the control desk. In conjunction with the extraordinary all-round vision from the fully-enclosed cab, this simplicity greatly minimizes fatigue and mental distraction, and ensure the fullest output from driver and locomotive.

*London Representatives:*
*Ferguson & Palmer, 9 Victoria Street, Westminster S.W.1.*

**PECKETT & SONS LIMITED, ATLAS LOCOMOTIVE WORKS, ST. GEORGE, BRISTOL 5. Tel: 65-5346. 'Grams: "Peckett" Bristol**

*Clean Feed Water*
means higher boiler efficiency and lower fuel costs!

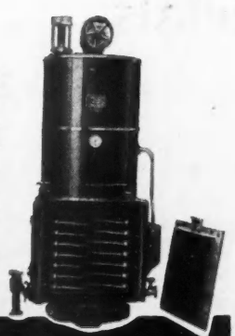
Feed water that deposits scale on boiler heating surfaces is a prime cause of overheating and subsequent tube collapse. And, remember, the majority of town water supplies, as well as sea-water, are heavy depositors of scale.

A Caird & Rayner Evaporator takes all the harm out of sea-water and provides a full supply of clean feed water to the boilers.

Not only is boiler efficiency raised and maintenance reduced appreciably, but substantial fuel savings will be seen as well.

Evaporators can be supplied to cope with feed water to any required rate. Further details will gladly be supplied on request.

**EVAPORATORS AND CONDENSERS. FEED WATER HEATERS. FEED WATER FILTERS. EXHAUST STEAM OIL SEPARATORS. OIL FUEL HEATERS.**

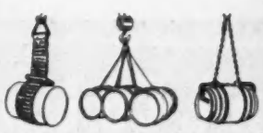


**Caird & Rayner LTD**
777 COMMERCIAL ROAD, LONDON, E.14. TELEPHONE EAST 3216 (3 lines) TELEGRAMS VAPORIZE LONDON

DHB/2712

# DRUM LIFTING TACKLE

We have drum lifting beams, slings, grabs and drum pourers in regular production which save countless man hours and minimise risk of injury. Drums can be dangerous — lift them safely with BERL Tackle. Write for leaflet.



**British Electrical Repairs Limited**

*Empire House, Charlotte Street, Manchester 1*

WORKS AT:
BATH, BIRMINGHAM, CARDIFF, CHESTERFIELD, EDINBURGH, GLASGOW, HAWICK, LONDON, MANCHESTER, NEWCASTLE, SWANSEA.

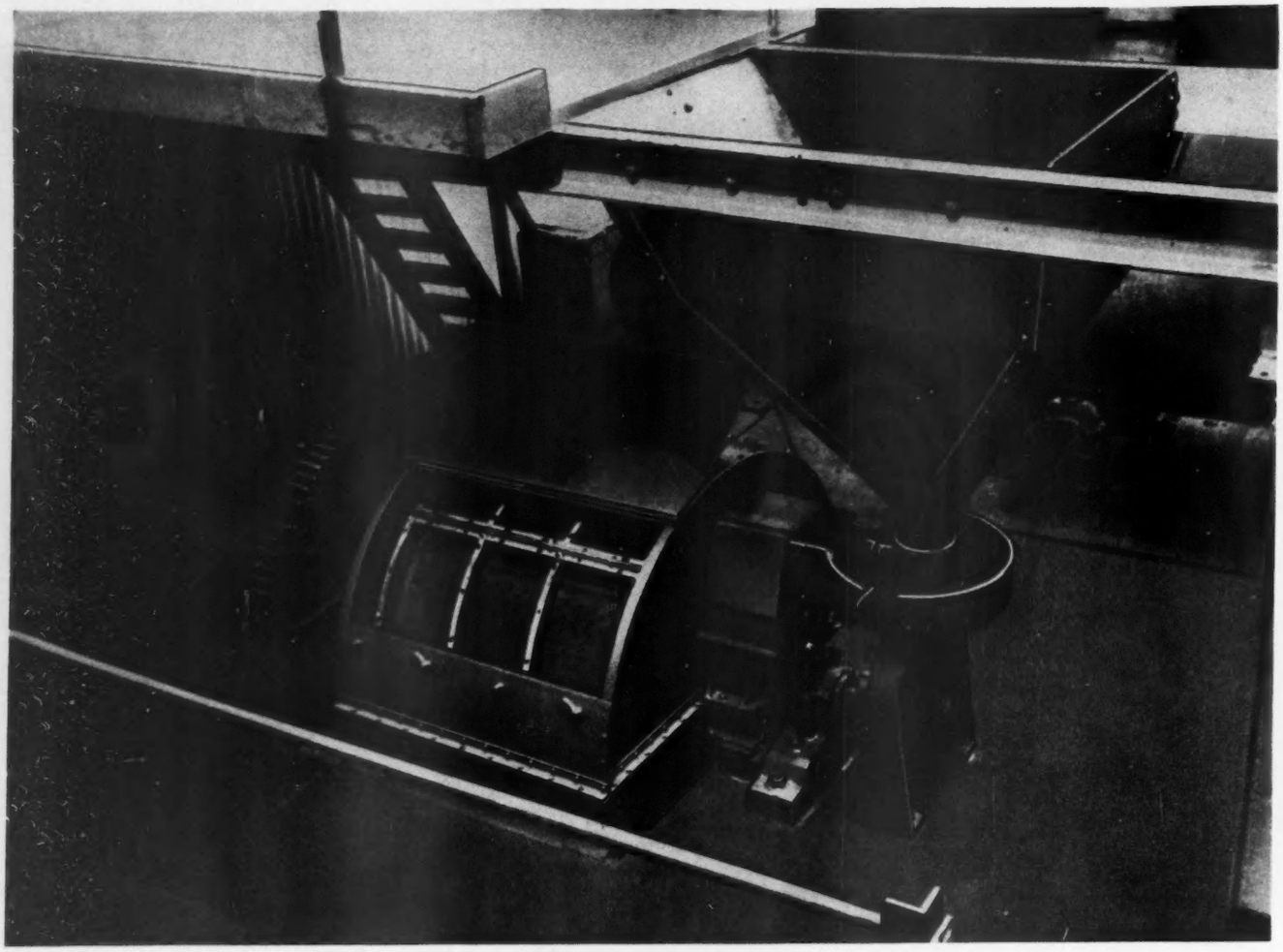
dm BER.68

ASK FOR DETAILS OF THE **VARIABLE STROKE OIL VALVE**

**Schieldrop**
PATENTED SELF PROPORTIONING
**OIL BURNER**

Set oil to air ratio at maximum and minimum with two adjustments only. No "trial and error."

SCHIELDROP & CO., LTD., STOTFOLD, BEDS. TEL: STOTFOLD 414 (3 lines)



# For reducing dry materials . . .

This ' Stag ' Ball Mill is available for you to witness full-scale trials on any suitable dry material you may require to reduce.

The Edgar Allen Experimental Department exists to conduct such tests for our customers, equipped with many other machines for grinding, pulverising, calcining, drying, screening and similar work, all of which you can see in operation.

If you have to reduce limestone, dolomite, slag, stone, quartz, refractory materials, ores, or some special material about the behaviour of which you would like practical information, we can arrange a test at which you can satisfy yourself about the rapidity and effectiveness of the reduction.

' Stag ' Ball Mills are arranged for continuous feed and discharge; the various sizes will take materials of maximum size from ¾in. to 4in. cube. Above all, ' Stag ' Ball Mills are made to sound and generous engineering design, based on our great experience in this field.

## EDGAR ALLEN 'STAG' BALL MILLS

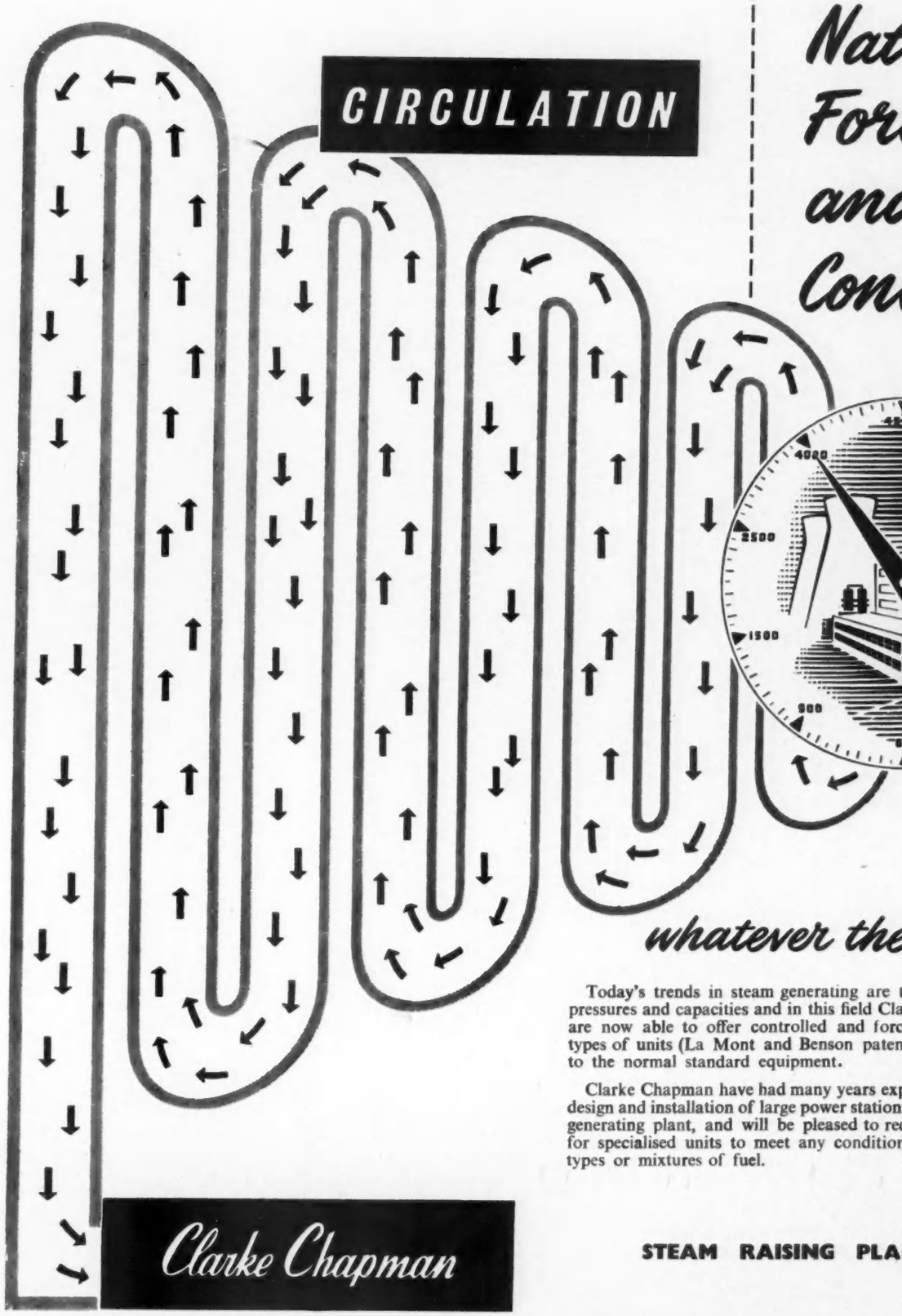
**Edgar Allen & Co. Limited**
IMPERIAL STEEL WORKS · SHEFFIELD · 9

*For this Booklet post the coupon to-day*

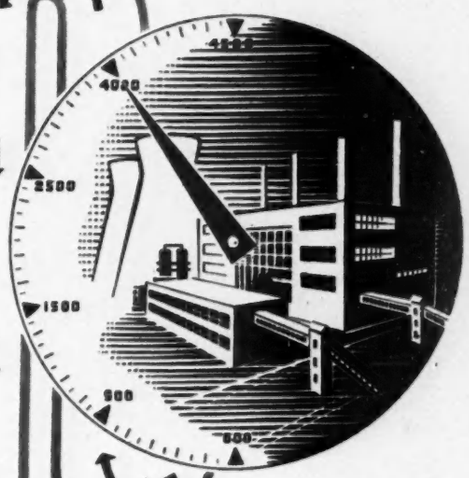
To EDGAR ALLEN & CO. LTD. Er/ED43
SHEFFIELD 9

Please post data on ' Stag ' Ball Mills to:

Name .....
Position .....
Firm .....
Address .....




*Natural Forced and Controlled*




*whatever the pressure*

Today's trends in steam generating are towards higher pressures and capacities and in this field Clarke Chapman are now able to offer controlled and forced circulation types of units (La Mont and Benson patents) in addition to the normal standard equipment.

Clarke Chapman have had many years experience in the design and installation of large power station and industrial generating plant, and will be pleased to receive enquiries for specialised units to meet any conditions and for all types or mixtures of fuel.

*Clarke Chapman*

**STEAM RAISING PLANT**

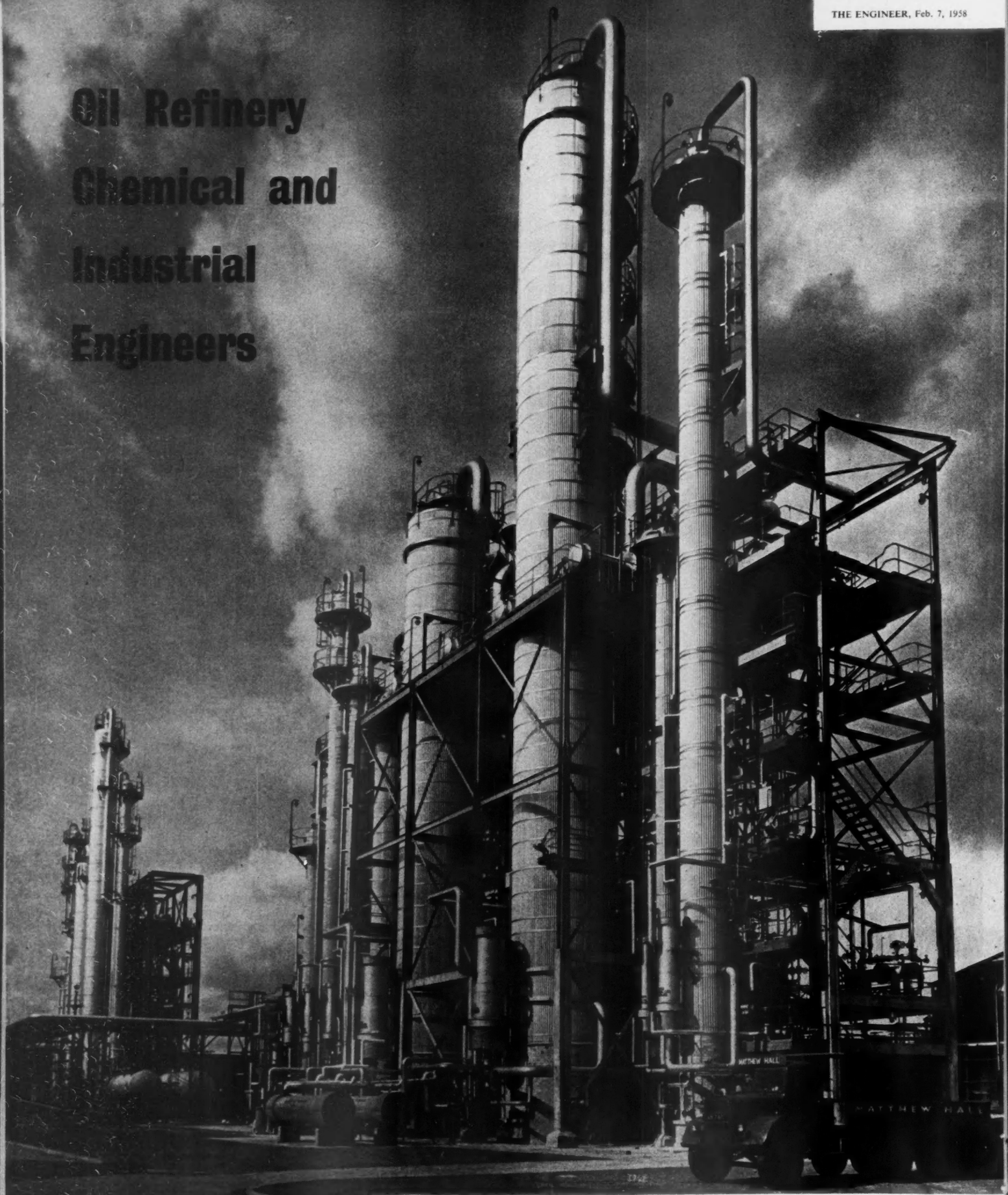
Water-tube Boilers and Ancillary equipment. Raymond Bowl and "Resolutor" Milling Plant. Fusion Welded Pressure Vessels. Erection Winches. Ash Conveyors.

**CLARKE, CHAPMAN & CO. LTD., VICTORIA WORKS, GATESHEAD, 8, CO. DURHAM**

**LONDON OFFICE: Dunster House, Mark Lane, E.C.3. MANCHESTER: 8 King Street, 2. GLASGOW: 116 Hope Street, C.2.**

M

# Oil Refinery Chemical and Industrial Engineers




THE

## MATTHEW HALL

GROUP OF COMPANIES

ESTD. 1848

MATTHEW HALL

MATTHEW HALL HOUSE, DORSET SQUARE, LONDON, N.W.1.

Manchester · Glasgow · Bristol · Belfast · Johannesburg · Germiston · Durban

Capetown · Welkom · Bulawayo · Salisbury (Central Africa) · Ndola · West Indies

# I'm more than a mere order number

'I like to deal with suppliers who treat their customers as individuals rather than order numbers. You know — the personal touch. You get it with J. & P.'

*'Johnson & Phillips? They carry out some pretty big electrical projects, don't they?'*

'They do. But they still manage to make every customer feel they're pleased to handle his business.'

*'Shows the advantage of dealing with a medium-sized firm.'*

'Yes indeed. J. & P. are just the right size for me.'

**THE RIGHT-SIZED FIRM FOR YOU**

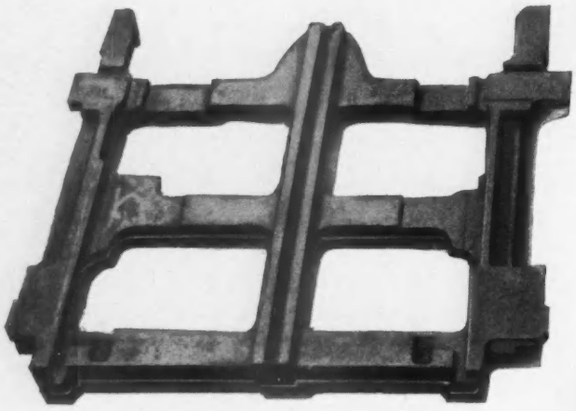
J. & P. manufacture cables, transformers, switchgear, capacitors, etc., and undertake electrification schemes for many of the largest industrial concerns in this country and overseas.
They have been in the business since 1875.
But they still retain that regard for the individual customer that only the smaller firms can have.

# JOHNSON & PHILLIPS

**A Power in the Electrical World**

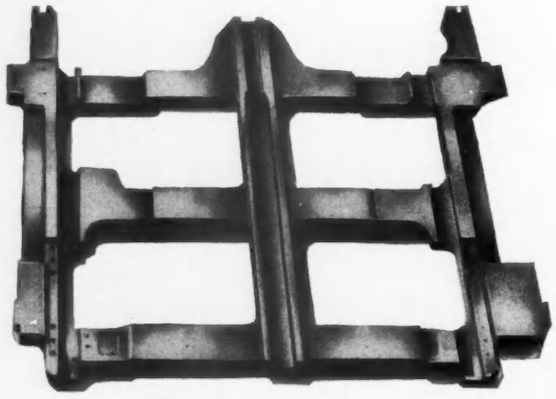
JOHNSON & PHILLIPS LTD · CHARLTON · LONDON S.E.7

**cast . .**



Overall dimensions approximately

30 inches square



Machined tolerances to ± .002 inches

on parts shown

**. . . and machined . .**

47 machining operations

**under one roof**

*Saves transport, double handling and storage space*

***Close proximity of foundries and machine shops ensures instant technical liaison***

We are equipped to machine most types of castings in the following materials:

**Aluminium Alloys**

**Magnesium Alloys**

**Copper-based Alloys**

**Steel Alloys**

**Cast Iron**

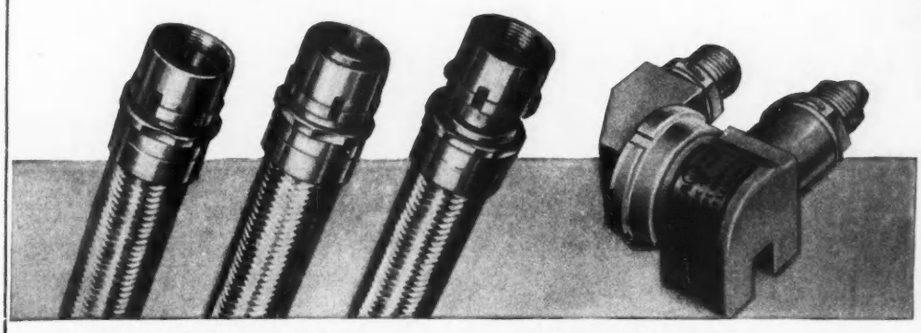
# KENT ALLOYS LIMITED

ROCHESTER, KENT · Telephone: Strood 7674

A member of the Birfield Group

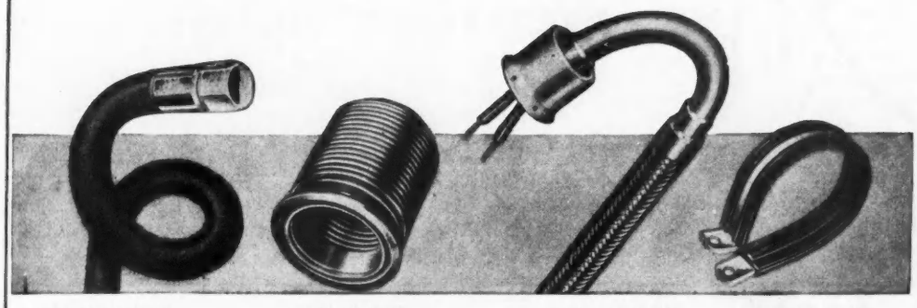
# first choice FOR FLUID MOVEMENT

***When it's a question of conveying a liquid or gas through a movable pipe, AVICA know the problems—and the answers. AVICA pipe assemblies and components are made for all kinds of duties and to work under the toughest conditions, such as extremes of temperature and pressure, corrosive atmospheres, continuous vibration. Above all, they are absolutely dependable.***



STAINLESS STEEL FLEXIBLE PIPE ASSEMBLIES
For most corrosive liquids and gases at temperatures from —183°C. to 450°C. Sizes from 3/16" to 4". End couplings of many types.

SWIVEL PIPE COULPLINGS
Used with rigid pipe when a flexible pipe is not suitable. Sizes 1/4", 3/8" and 1/2". For hydraulic and other fluids at pressures up to 4000 p.s.i.



SYNTHETIC RUBBER FLEXIBLE PIPE ASSEMBLIES
Used to carry petrol, oil, air steam, hydraulic fluids, for machine tools, hydraulic presses, mining equipment at pressures up to 5000 p.s.i. Size range (i.d.) 5/32" to 2". Temperature range—40°C. to 160°C.

STAINLESS STEEL BELLOWS ASSEMBLIES
Take up thermal expansion and contraction in rigid pipes and ducts, also changes due to pressure variation. Used as seals in valves and pressure regulators. For temperatures up to 450°C.

WIRING HARNESS
Electrical wiring protected by rigid or flexible conduit from heat, oil, moisture and vibration.

SUPPORT CLAMPS
To hold piping and electrical cables. The rubber cushion absorbs vibration; can be replaced when worn or perished.

Illustrated leaflets describing the full range of AVICA products are available on request. Please write for those that interest you.

AVICA

**AVICA EQUIPMENT LIMITED · MARK ROAD · HEMEL HEMPSTEAD · HERTS**

*Tel: Boxmoor 4711* *Cables: Avica Hemel Hembstead*

"The trouble is, he's a new G.G.L. fan, and they always go on and on about G.G.L. service and quality when they first discover it. Mind you, it is wonderful the way you get accurate, top quality work at the right price and the right time."—"Don't talk to me about time," mutters the waiter.

***CAPSTAN AND AUTOMATIC WORK AND SHEET METAL PRESSINGS, IN ANY METAL, ANY FINISH, ANY QUANTITY***

*FOR QUICK SERVICE AT THE RIGHT PRICE GET IN TOUCH WITH:*

**GRIFFITHS, GILBART, LLOYD & CO. LTD.**

Empire Works, Park Road, Birmingham, 18
Tel: Northern 6221

**G·G·L**

---

**POSITIVE REMOTE CONTROL AT YOUR FINGER TIPS**

Wherever the application of an efficient positive remote control system is required the ARMSTRONG Unit provides a simple, effective answer. Easy to install, rust-proof, permanently self-lubricated and temperature corrected, neither the 'Slave' nor 'Master' units need maintenance. Amongst innumerable applications, flue damper controls, built in systems for Machinery Controls and Motions, remote gear shift operations, jig latching and valve control, etc., are typical.

*Full information gladly supplied.*

**ARMSTRONG**
Regd. Trade Mark
**REMOTE CONTROL UNIT**

**ARMSTRONG PATENTS COMPANY LIMITED**
**EASTGATE · BEVERLEY · YORKSHIRE**

---

**don't be prehistoric . . .**

# get a jump ahead with WESTOOL solenoids

Whether you make machinery, or simply use machines in your production processes, Westool Solenoids can help you get one jump ahead of your competitors. Westool Solenoids are compact, self-contained, electro-magnetic units which can be fitted anywhere to provide a direct mechanical action automatically, or by remote push-button control. Solenoid actuation can lift, lower, push, pull, open or shut, thus simplifying machine designs, speeding up operations and reducing production costs.

Westool Solenoids have been used in domestic washers, dry cleaners, can packers, ticket issuing machines, spot welders and concrete batching plant—to name but a few applications.

*Write now for full details of Westool A.C. and D.C. Solenoids and prepare yourself for that jump ahead.*

**WESTOOL LIMITED**

**ST. HELEN'S AUCKLAND, CO. DURHAM**

**Phone:** West Auckland 317 (6 lines) **Grams:** Solenoid, West Auckland

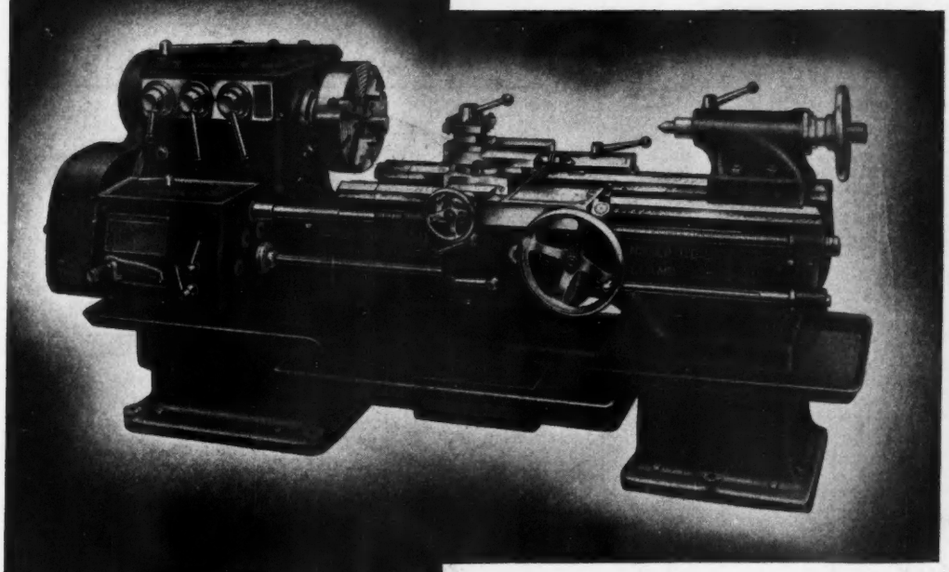
Birmingham Office: 7 Newhall Street, Birmingham, 3 · Telephone: Central 3901

*Westool also make: Coils and Coil Winding Machines, Transformers and Chokes, Grinding Attachments, Air Conditioners, Warner Electric Brakes and Clutches etc.*

TIB 93

CROWTHORN

# 7½" & 8½" CENTRE LATHES



CROWTHORN

The most popular of the Crowthorn range, these lathes include in their specification a robust vee type bed, timkenised headstock with large hollow spindle, quick change gearbox and multi position four way toolpost. A hexagon turret is available for either Herbert or Ward tooling equipment.

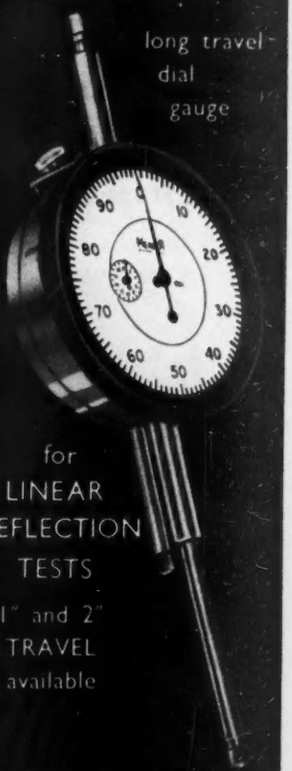
*Please write for detailed literature.*

CROWTHORN ENGINEERING COMPANY LIMITED
*High Class Machine Tool Makers*
REDDISH · STOCKPORT · ENGLAND
*Phone: STOCKPORT 7271-2-3 Grams: CROWTOOL, REDDISH*

CL90

MERCER

long travel dial gauge



for LINEAR DEFLECTION TESTS
1" and 2" TRAVEL available

THOMAS MERCER LTD.
1858 1958
ST. ALBANS · ENGLAND
Tel. ST. ALBANS 55313

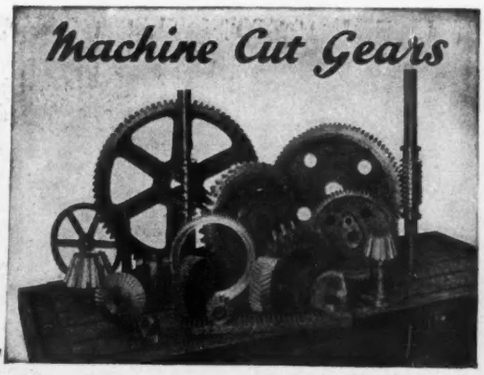
STONE BREAKERS
CRUSHING ROLLS
SCREENS
ELEVATORS and CONVEYORS
Makers
R. BROADBENT & SON, LTD.
STALYBRIDGE

SPRINGS AND SPRING WASHERS
FOR ENGINEERING PURPOSES

Manufactured by
JOHN TONKS & CO LTD.
CENTRAL SPRING WORKS
Furnace Hill, SHEFFIELD. 3
Telephone: SHEFFIELD 24679 Telegrams: TONKS SHEFFIELD 3

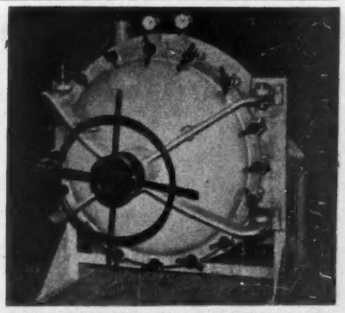
SPURS
BEVELS
WORM WHEELS
HELICALS
CHAIN GEARS
Complete Supply Cutting only

Machine Cut Gears



WORMS
RACKS
SCREWS
SILENT GEARS
CHANGE GEARS
All materials standard pitches to 7ft diameter

General machine castings made to customers' patterns. Low prices for planing, boring, turning, screwcutting
Send your enquiries to
GREENWOOD'S STANDARD GEAR CUTTING CO. LTD.,
New Bond Street, Halifax. Telephone: Halifax 521/78 Telegrams: "Gears."



RICHMOND WELDING CO.
Fabrications, Large and Small. Stainless Steel, Copper and Aluminium Welded by the Argon Arc or the Argonaut Process. Engineering.
Tele.: BRADFORD 25405
Established 1929

## Marking Devices by Specialists

PUNCHES
EMBOSSING &
PRESS TOOLS
BRANDS
NUMBERING
MACHINES

*WHENEVER YOU MARK ON METALS*

**H. B. SALE • LTD**

PROGRESS WORKS SUMMERLANE BIRMINGHAM

Telephone: CEN 5661/3 Grams: SALE, BIRMINGHAM

Established 1862

## WOOTTON BROS. LTD.

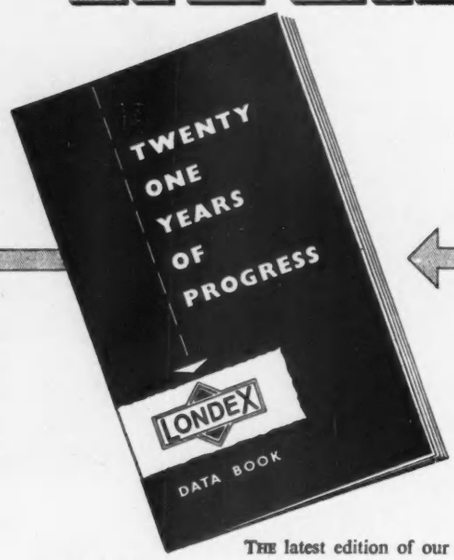
**COALVILLE IRON WORKS, COALVILLE**
**NR. LEICESTER**

Clay Working Machinery for Brick and Pipe Works. Colliery Plant. Iron and Brass Founders and Cast Steel. Hammered Steel and Iron Forgings. Steel Stockists. Arc Welding. C.Y. Non Abrasive Alloys to Order.

Established 1876

Telegrams: WOOTTON, COALVILLE. Telephone No. 22.

## RELAYS




THE latest edition of our Data Book entitled "Twenty-one years of progress," which now contains 40 pages, has just been published. It contains illustrations and specifications of our full range of products comprising; **Relays, Process Timers, Pressure and Vacuum Switches, Liquid Level Controls, Flow Indicators, Photo-Electrical Control Equipment, etc.**

*If YOU use Automatic Electrical Control Apparatus a FREE copy will gladly be sent on request.*

**LONDEX LTD.**

**ANERLEY WORKS, LONDON, S.E.20.**

Telephone: Sydenham 3111

*We're losing our grip* SAID THE NUT TO THE BOLT

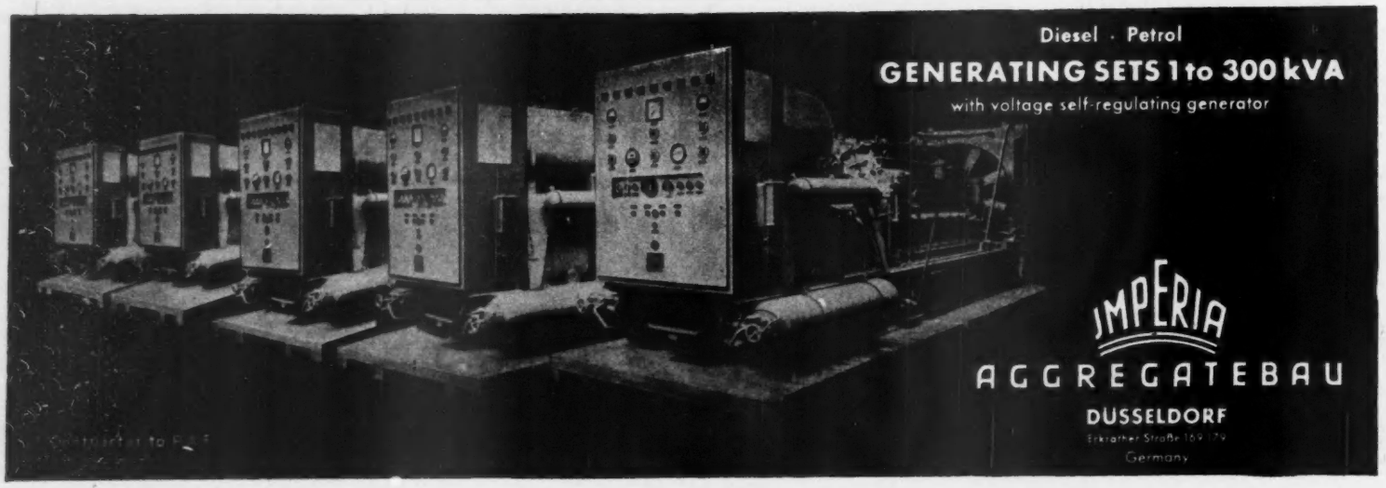


*We need a* **KOLOK** *Positive Lock Washer*

Forget about vibration and slackness—fit a Kolok Positive Lock Washer between each nut and bolt.

**POSITIVE LOCK WASHER CO. LTD., 45 RENFREW STREET, GLASGOW**

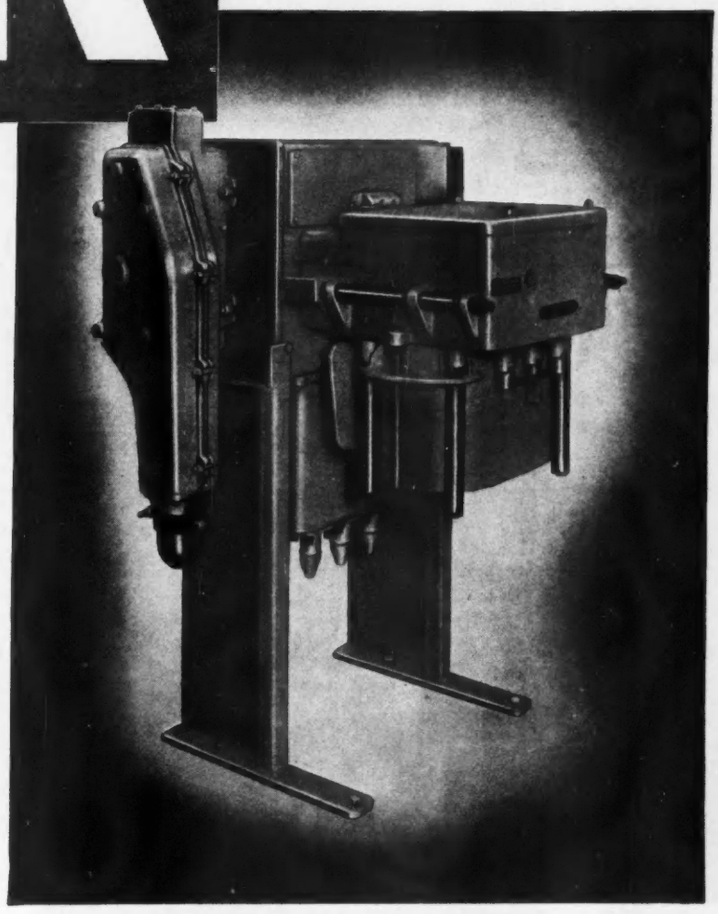
Telephone: DOUglas 9292



***Where the need is for supply up to 660V-1200A***

**-the choice should be TYPE 'K'**

# industrial switchgear

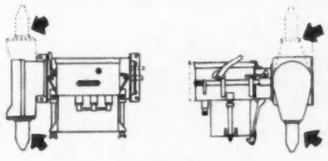


Type 'K' Switchgear—readily adaptable for any factory layout—provides the best answer to the problem of industrial supply. It is available in pedestal or cubicle mounted arrangement and incorporates oil circuit-breakers suitable for direct-on motor starting and for use in conjunction with rotor starters for slip-ring motors.

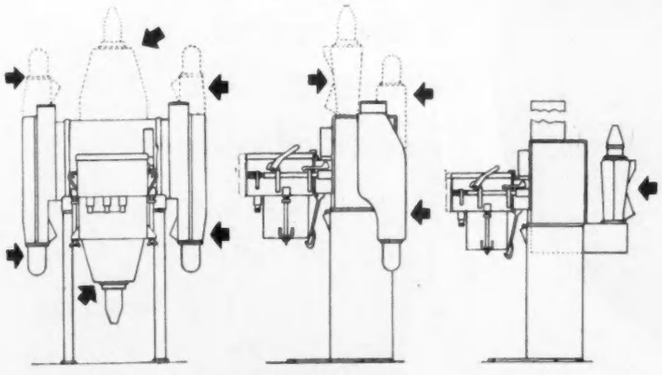
*Single mounting pedestal type K5 switch unit*

RELIABLE • COMPACT SWITCHGEAR

ALTERNATIVE CABLE BOX POSITION



*Wall mounted type*



*Pedestal mounted type*

***Specify Type 'K'***

**INDUSTRIAL SWITCHGEAR**

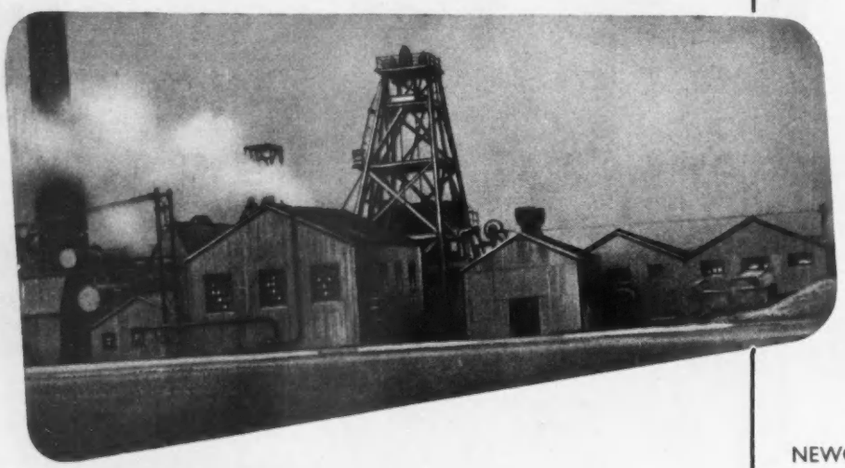
***for medium voltage service***

**Ferguson Pailin** LIMITED *An A.E.I. Company* — *for Switchgear*

*Head Office & Works:* **HR. OPENSHAW MANCHESTER 11,** *Telephone :* DROylsden 1301 (Pte.Branch Ex)

LONDON OFFICE : Bush House, Aldwych, W.C.2 BIRMINGHAM OFFICE : Windsor House, 656 Chester Road, Erdington, 23 GLASGOW OFFICE : Central Chambers, 109 Hope Street, C.2.

*REPRESENTED IN PRINCIPAL OVERSEAS TERRITORIES*



**MACHINERY INSTALLATIONS LIMITED**

**60a HIGH ST · ACTON · LONDON W.3 · ACORN 6044 P.B.E.**

**TRANSPORT · ERECT and DISMANTLE ALL TYPES OF MACHINERY BOILERS and CHIMNEYS etc., etc.**

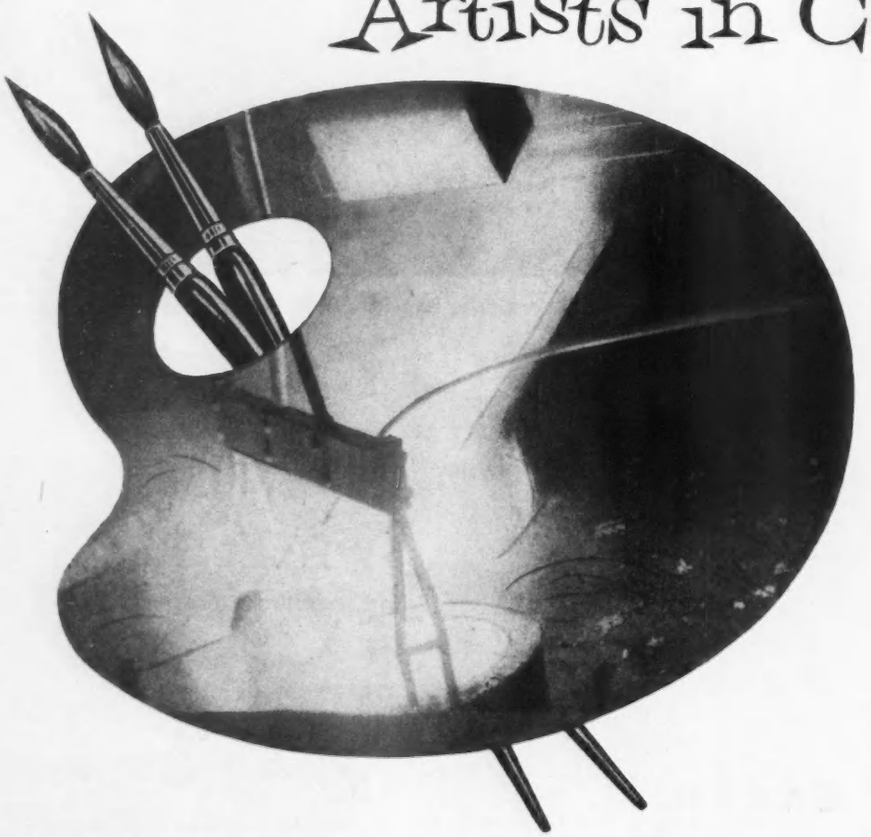
for

**M.I.L.**

**SERVICE**

telephone
BIRMINGHAM
MIDLAND 5731 P.B.E.
CARDIFF 25471
GLASGOW CITY 6597
NEWCASTLE UPON TYNE 22336

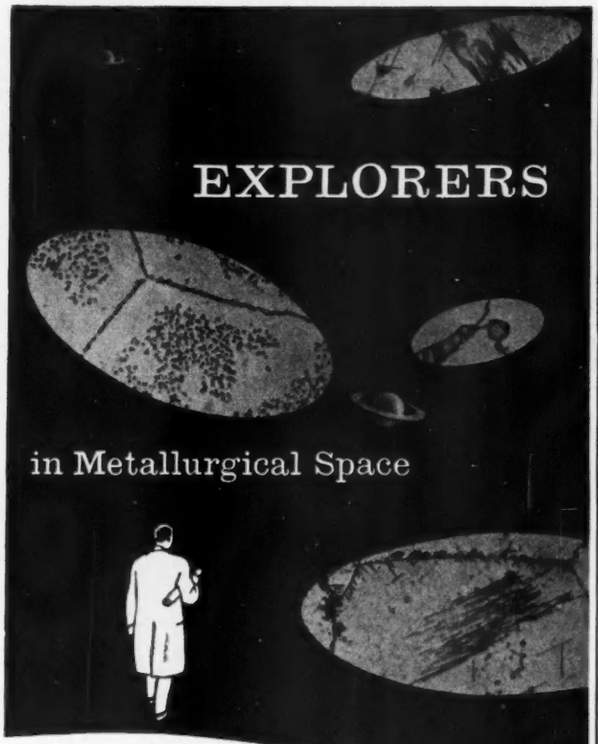
# Artists in Carbon Steel Castings



- **ALLOY STEELS**
- **CARBON STEELS**
- **HEAT RESISTING STEELS**
- **STAINLESS STEELS**
- **CORROSION RESISTING STEELS**

*All castings can be machined in our modern machine shops*

**LAKE & ELLIOT, LTD.,**
BRAINTREE · ESSEX
TELEPHONE: BRAINTREE 1491




Henry Wiggin & Company Ltd., makers of high nickel alloys, have been exploring metallurgical fields for over one hundred years. The resources which led to the production of the Nimonic Series of Alloys and made the gas turbine engine practicable will one day be applied in interstellar transport. Meanwhile, they are being directed to a variety of industrial developments on this planet.

'NIMONIC' IS A REGISTERED TRADE MARK

**Join the teams who aid vital developments**

***IN EVERY FIELD OF INDUSTRY***

**Vacancies currently exist for**

**MECHANICAL ENGINEERS**
**CHEMICAL ENGINEERS**
**METALLURGISTS**
**PHYSICISTS**
**ANALYTICAL CHEMISTS**
**in**

**The Metallurgical Department** on work associated with Process and Product Development and Quality Control for which only first class honours men, preferably with post-graduate experience and training either at a University or in a Research Field, will be considered.

**The Production Department** for Shift Technical Assistants with responsibilities for Quality Control and Administration for which persons with first or second class honours degrees, or equivalent qualifications, will be considered. Preference will be given to those having industrial experience.

**The Technical Service Section** of the Sales Department for three mechanical engineering graduates, or equivalently qualified persons, with industrial experience in the fields of gas turbine, automotive or general high temperature engineering.

**The Area Sales Offices** at Birmingham, Glasgow and London for graduates of suitable personality and a desire to meet people and to discuss technical problems.

*Apply to the Assistant Managing Director quoting Ref. A.1.*

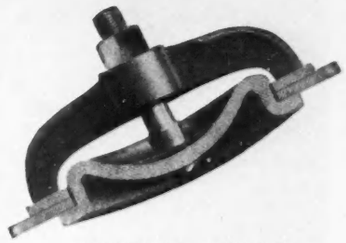
*Laboratories and factories in Birmingham, Glasgow and Hereford.*

**HENRY WIGGIN & COMPANY LIMITED, WIGGIN STREET, BIRMINGHAM 16**

YGA CLI/1

**McNEIL**

*manhole doors for air-receivers, boilers, etc.*



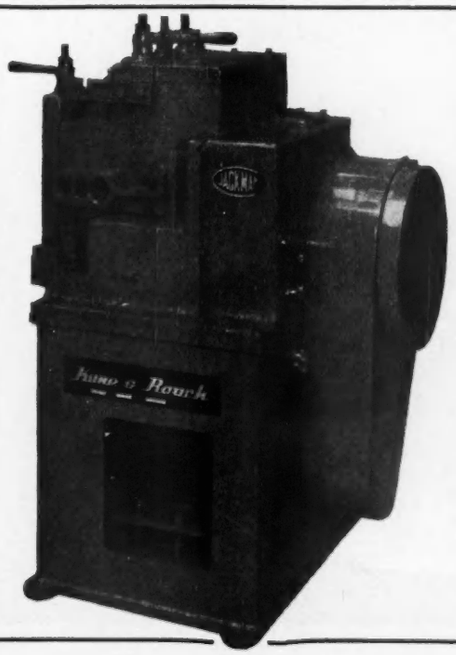
**HEAVY STEEL PRESSINGS**

**FOUNDRY LADLES**

**FABRICATED STEELWORK**

**WELDED CENTRAL HEATING BOILERS**

**CHARLES McNEIL LIMITED**
**KINNING PARK HYDRAULIC FORGE**
570 SCOTLAND STREET, GLASGOW, S.1.
Grams: "McNeil, Glasgow" Phone: South 1131



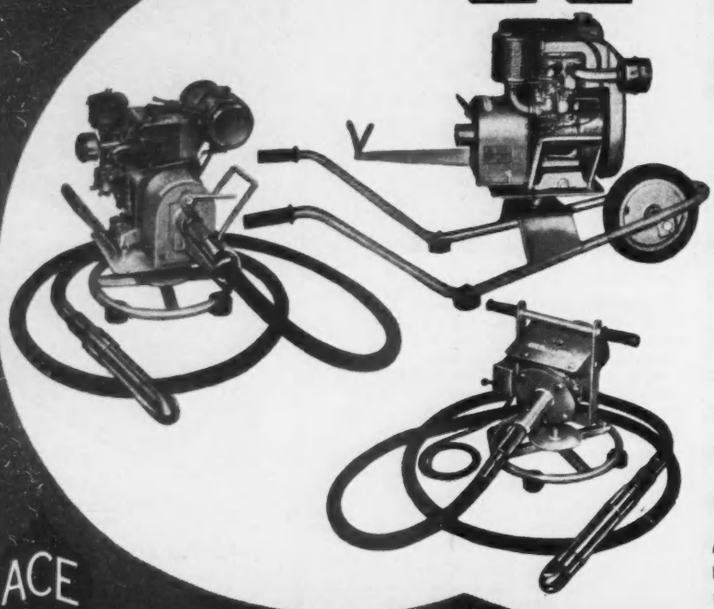

RECLAIM USED CORE WIRE WITH MANCHESTER-BUILT *KANE & ROACH* CORE WIRE STRAIGHTENERS.

RESTRAIGHTEN CORE WIRE TO USABLE CONDITION— OVER AND OVER AGAIN, CHEAPLY AND EFFICIENTLY.
CAPACITIES $\frac{1}{8}$" TO $\frac{3}{8}$" DIA. AND $\frac{3}{16}$" TO $\frac{3}{4}$" DIA. WIRE.
ROLLS OF HARDENED STEEL.

FOR DETAILS WRITE TO

J. W. JACKMAN & COMPANY LIMITED
VULCAN WORKS, BLACKFRIARS ROAD, MANCHESTER, 3.
*Telephone :* DEANSGATE 4648-9. *Telegrams :* "BLAST" MANCHESTER

HUMDINGER



ACE

ACE

***The Higher Frequency Vibrator with the***

**SLOW SPEED DRIVE**

'HUMDINGER' frequencies of 10/12,000 VPM can deal more efficiently with the harshest 'mixes'. Equally important is the established fact that the **flexible drives keep running week after week.** That is why so many leading contractors have changed to this new Vibrator — it reduces hold-ups, in addition assures lower vibrating costs on every cubic yard placed. Please write for leaflet.

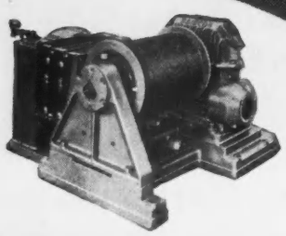
**Now available for Trial, Hire or Sale**

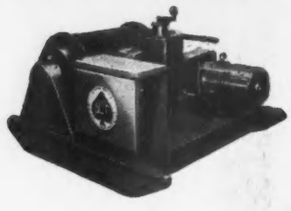
***PETROL OR ELECTRIC***

**ACE MACHINERY LIMITED**

**Porden Road, Brixton, London, S.W.2**
**Telephone: BRIxton 3293 (9 lines) and at Brentford**

***WINCHES*** FOR HAULING, HOISTING, ERECTING AND CONSTRUCTION DUTIES





ACE

Standard and special types for steel erecting, skip hoists, transporters, wharf cranes, general haulage and building construction. Capacities from half ton (500 kilos) upwards. Send for full particulars.

*use* **ACE** *winches*

**ACE MACHINERY LIMITED**
**Harlequin Avenue, Great West Road, Brentford, Middlesex**
**Telephone: EALing 6262 (5 lines)**

ACE

**RADIALS** for structural engineers

The E.G.C. machine, a line of which is shown above, has been specially developed to provide simple, fast holemaking equipment for plate and girder work. Write for a catalogue and get full details.

**WILLIAM ASQUITH LTD.**
HALIFAX · ENGLAND

*Sales & Service for . . .* **DRUMMOND-ASQUITH** *. . . the British Isles*

DRUMMOND-ASQUITH (SALES) LTD., KING EDWARD HOUSE, NEW ST., BIRMINGHAM

*'Phone : Midland 3431 (7 lines) 'Grams : Maxishape, B'ham. Also at LONDON : Phone : Trafalgar 7224 (5 lines) and GLASGOW : 'Phone : Central 3418*

A149

N

*For Good Sound*

# BUSHES & BLANKS

*Specify*

# ESCO

# 'Rotocast'

## BRONZE

Sizes 3½" — 21" diameter in Phosphor Bronze, Lead Bronze or Gun Metal for Bushes or Worm Wheel blanks

THE **EYRE** SMELTING COMPANY LIMITED

**TANDEM WORKS MERTON ABBEY LONDON SW19**

Telephone: MITCHAM 2031

**Also makers of TANDEM WHITE METALS & ESCO GUN METAL INGOTS etc.**

**All enquiries for ALUMINIUM should be sent to ALUMINIUM WORKS WILLOW LANE, MITCHAM, SURREY. Telephone: MITCHAM 2248**

**35 years of constant progress in acid resisting plastic materials lie behind the new fibre-glass material**

**KEEGLAS** in Chemical Resistance is equal to some of the excellent properties of Keebush.

**KEEGLAS** Temperature Resistance is up to 130°C.

**KEEGLAS** is resistant to Thermal Shock.

**KEEGLAS** is available in a wide variety of forms such as tanks, piping towers, etc.

# KEEGLAS

The latest addition to the well-known range of Keebush Materials supplied by the Kestner Evaporator & Engineering Co. Ltd.

*For further information write to:*

KESTNER EVAPORATOR & ENGINEERING CO. LTD.

**5, GROSVENOR GARDENS, WESTMINSTER, LONDON, S.W.1**

# ELECTRIC R.P.M INDICATORS

*UP TO 8" DIAMETER*

# WYNSTRUMENTS LTD

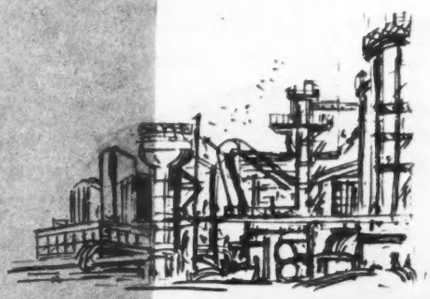
STAVERTON AERODROME · GLOUCESTER

Phone: CHURCHDOWN 3264

*the best* SPL *pipework is*

CLYDE BUILT

*the fittings* CTF *have this stamp*



*you are assured of*

RELIABILITY

*The term 'Clyde-built' has brought an old but true meaning of reliability to the oil industry in the making, fabricating and erection of welding pipe fittings.*

*Clyde Tube Forgings design the fittings . . .*

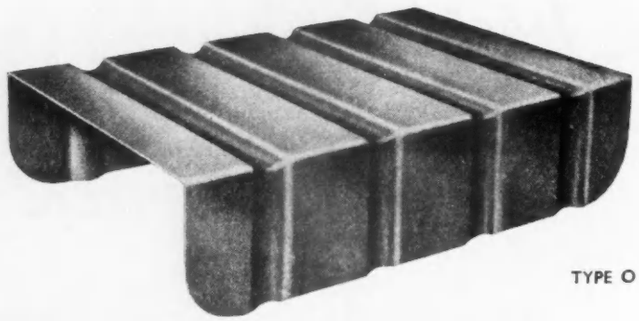
*Shaw Petrie Ltd. fabricate and erect the pipework . . .*

**CLYDE TUBE FORGINGS LIMITED**
**SHAW PETRIE LIMITED**

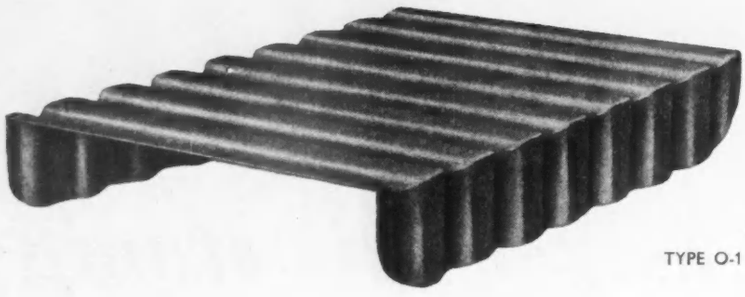
**NORTH HILLINGTON, GLASGOW, S.W.2**
TELEPHONE, HALFWAY 5551-6
**LONDON OFFICE, 157 VICTORIA STREET, S.W.1**
TELEPHONE, TATE GALLERY 9325-6
**AND AT SOUTH SHIELDS, LIVERPOOL & BELFAST**
**CANADIAN CLYDE TUBE FORGINGS,**
**P.O. BOX 278, WESTON, ONTARIO, CANADA**

NEW ZEALAND · EAST, WEST CENTRAL AND SOUTH AFRICA · AUSTRALIA
BARBADOS · BRITISH GUIANA · JAMAICA · TRINIDAD · ITALY · SPAIN
MEXICO AND VENEZUELA · BELGIUM · HOLLAND · NORWAY · SWEDEN AND FINLAND

# ALL-METAL STILLAGE PLATFORMS

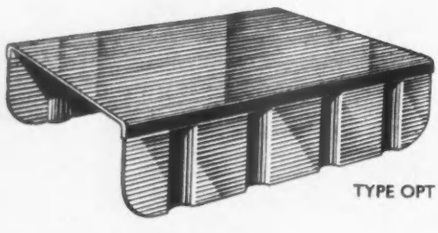


TYPE O

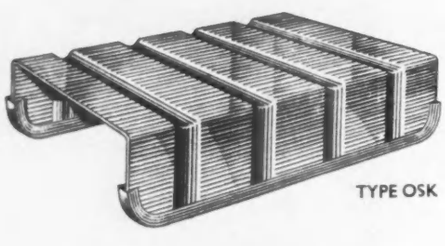


TYPE O-1

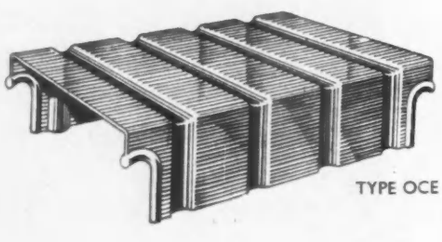
*Produced to specification to suit individual requirements*



TYPE OPT



TYPE OSK



TYPE OCE

Made from mild steel plate, corrugated for maximum strength, these stillage platforms need no maintenance, are virtually indestructible and consequently are a most economical proposition. The body is of one-piece construction, eliminating the use of angle irons, bolts and nuts.

There are no projections to get in the way and nothing to work loose.

Where a flat top surface is required, the platforms can be supplied fitted with plain M.S. or aluminium covers as Type OPT illustrated on left. They are also available with skids to permit sliding over floors (Type OSK), or with ends cut away for slinging (Type OCE).

FINISHES: Galvanized or painted or self-colour.

QUOTATIONS AGAINST SPECIFICATION: Please state pattern, load to be carried, type of truck, height and width inside corrugations and length.

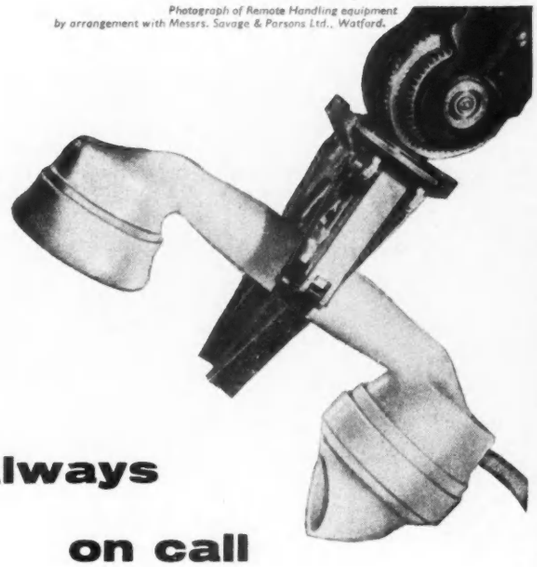
*Ask for List No. E930 or send details of requirements.*

**Harvey**

G. A. HARVEY & CO. (LONDON) LTD. · WOOLWICH ROAD · LONDON · S.E.7

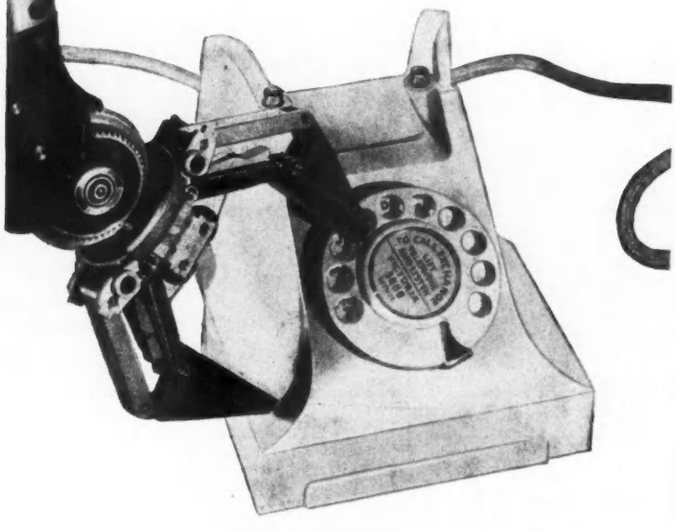
*Telephone:* GREenwich 3232 (22 lines) *Telegrams:* "Cheaper, Wol, London"

Photograph of Remote Handling equipment by arrangement with Messrs. Savage & Parsons Ltd., Watford.



## Always on call

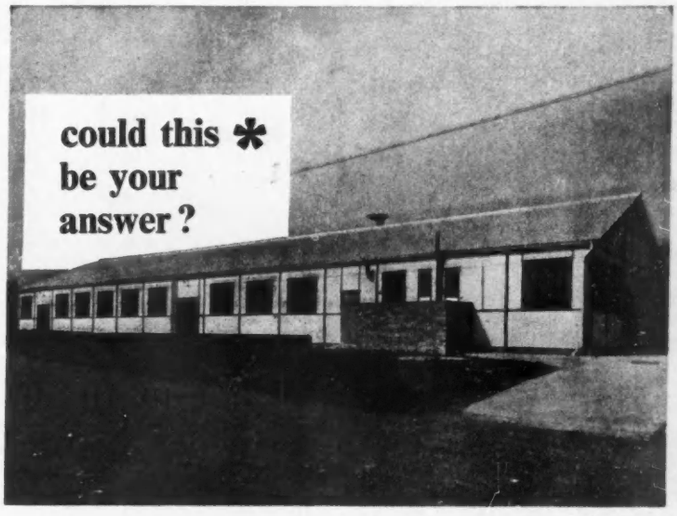
When you get through to Edgbaston 2245 you are in touch with a firm that specialises in Nickel and High-Nickel Alloys —Henry Wiggin and Company.



We are always glad to supply information on our extensive range of alloys and will help you to find the right material to serve in conditions where more common metals are inadequate. If you need a material to withstand corrosion, high temperatures or one with special properties of thermal expansion, elasticity, electrical resistance or magnetism then Wiggin can help you.

HENRY WIGGIN AND COMPANY LIMITED
WIGGIN STREET · BIRMINGHAM 16 · EDGBASTON 2245

TGA 1613




Photograph by courtesy of Thomas Harrington Ltd., Hove, Sussex

* **For one reason or another, tomorrow may find you face to face with a complex building problem demanding an urgent solution . . . or funds will not permit the expense of a traditional brick structure.** Whichever it is, YOU are expected to find a speedy, efficient answer. Just such an answer is provided by THORNS TIMBER-FRAMED BUILDINGS.

Prefabricated in BASIC units, they combine economy with ease of erection—and are easily adaptable to your own design.

The photograph shows a canteen building size 120 ft. × 37 ft. × 10 ft. containing dining hall, kitchen and store.

**Basic widths available: 12 ft., 15 ft., 18 ft., 20 ft., 24 ft., 25 ft., 30 ft.**

*get your quotation from* **THORNS**

J. THORN & SONS LTD. (Dept. 81), BRAMPTON ROAD, BEXLEYHEATH, KENT

BD 939A

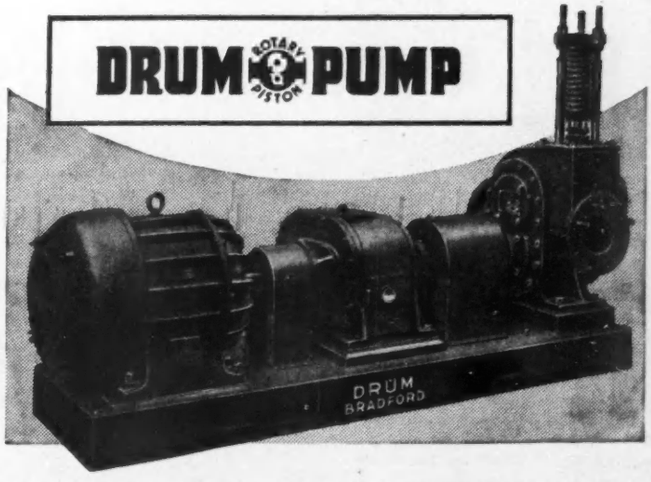
## PUMPS for the PETROLEUM INDUSTRY

*Below: Motor driven Oil Transfer Pump; 50 tons/hr.*

**150 to 100,000 g.p.h.; temperatures up to 600° F.**

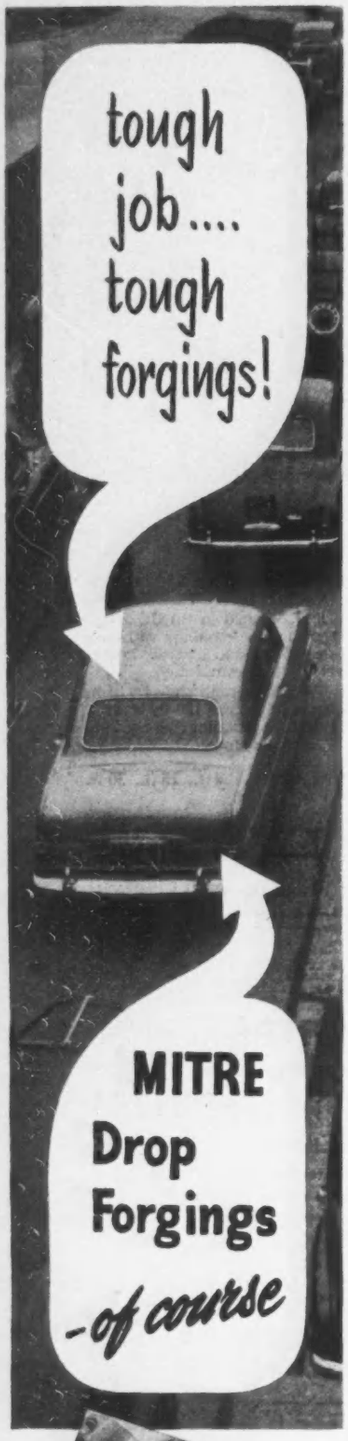
DRUM Pumps meet the requirements of the petroleum industry in a unique way and are suitable for liquids from the most volatile to the most viscous, over a wide range of temperatures. Cargo, bunkering, transfer, road tanker, refuelling pumps, etc.

**DRUM ROTARY PISTON PUMP**




THE DRUM ENGINEERING COMPANY LIMITED.
HUMBOLDT STREET, BRADFORD. TELEPHONE: BRADFORD 22358
London Office:
38, Victoria Street, Westminster, S.W.1 Telephone: ABBey 3961
Branch Offices in Glasgow, Newcastle, Manchester and Birmingham.

DR46



SEND *for a copy of this illustrated folder.*

A.J. VAUGHAN & CO.
(MITRE WORKS) LTD.
WILLENHALL, Staffs. phone: 486-7

# G.E.C. 'LIMPET' LANTERN
## for SIDE ROAD lighting

The lantern has been designed for side road lighting using two 60 watt Osram Tungsten Lamps or one 80 watt Osram Mercury MB/U or MBF/U Lamp.

*New features include :—*

- ✳ Die-cast light alloy body arranged for wall mounting, thus dispensing with the necessity for columns and the obstruction they might cause in certain situations.
- ✳ Lamp operating gear, where necessary, housed within the body.
- ✳ Lantern enclosed by a diffusing opal "Perspex" bowl secured by a quick release toggle catch.
- ✳ All surfaces smooth for ease of cleaning.

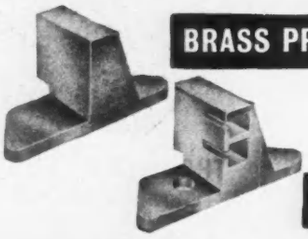
THE GENERAL ELECTRIC CO. LTD., MAGNET HOUSE, KINGSWAY, LONDON, W.C.2

## The choice is often difficult

- DIE CASTINGS in Brass, Bronze or Aluminium, cut costs by the reduction of machining and finishing operations and by the virtual elimination of machining allowances.
- BRASS PRESSINGS, on the other hand, can be produced so rapidly that, in many cases, the nett unit cost is lower.

*The problem is to choose the most suitable process for your needs.*

Why not call in the Non-Ferrous people first ? They can advise you well for they make *both !* Together with their associate company, Brass Pressings (London) Ltd., they conduct joint administrative, technical and engineering operations under one roof . . . their recommendations to you are therefore sound and unbiased.



BRASS PRESSINGS (LONDON) LTD.

*If requested, our technical representatives will be pleased to advise you without obligation.*

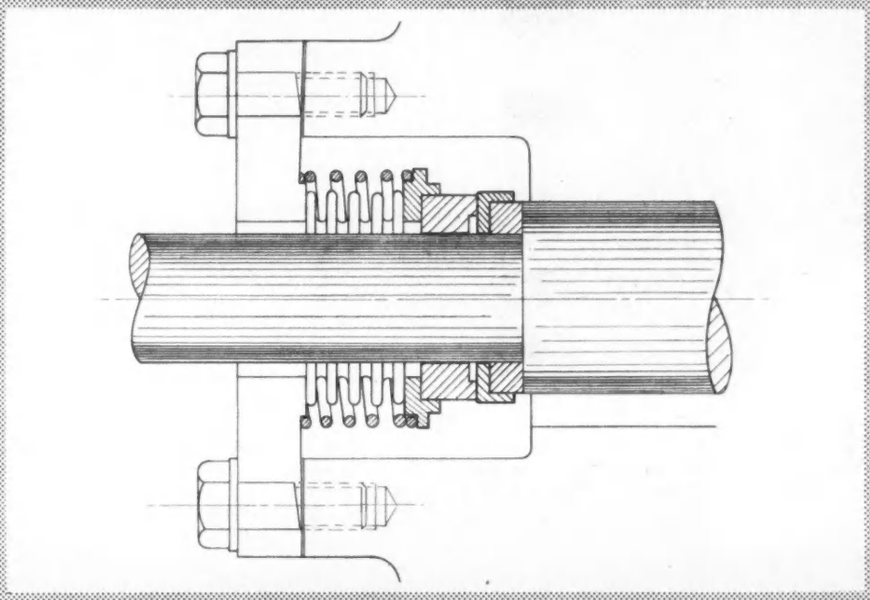
THE NON-FERROUS DIE CASTING CO., LTD.

NONFERDICA WORKS, NORTH CIRCULAR ROAD, LONDON, N.W.2 · Telephone: GLAdstone 6377 893

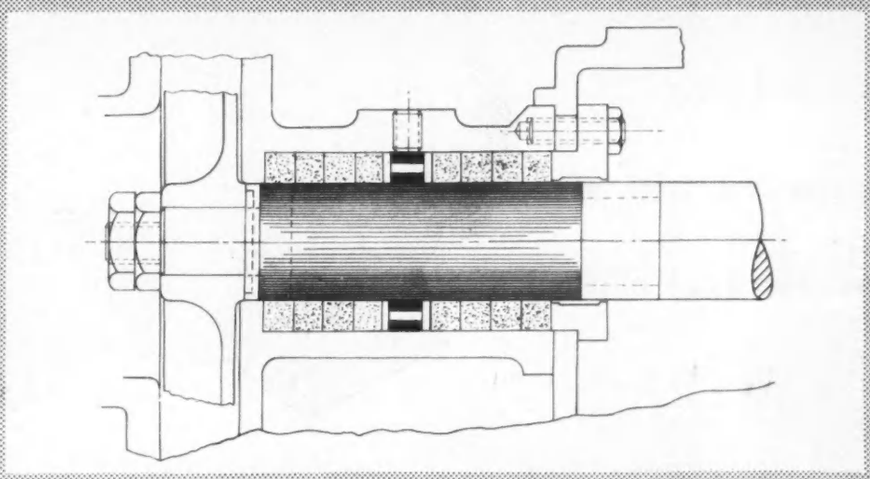
DELORO STELLITE

# STELLITE FOR PUMP SEALS, SLEEVES AND SHAFTS

Faced or solid components
supplied by all leading makers.



**THE ANSWER TO WEAR PROBLEMS CAUSED BY ABRASIVE AND CORROSIVE CONDITIONS**



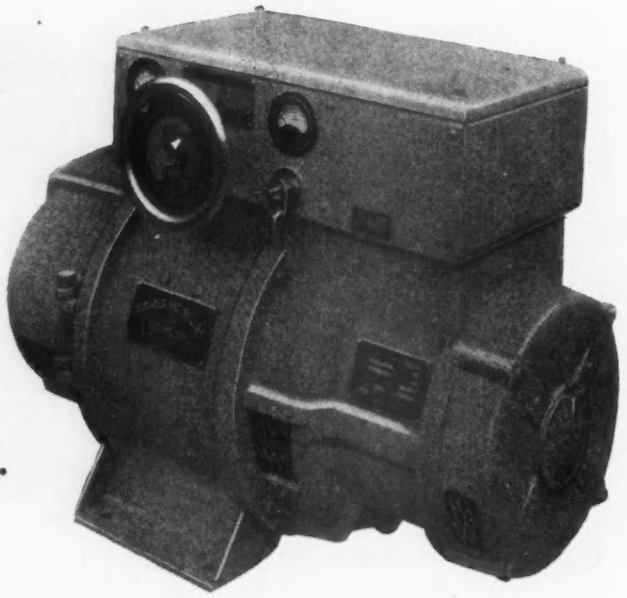
DELORO STELLITE LIMITED · HIGHLANDS ROAD · SHIRLEY · SOLIHULL · WARWICKSHIRE
DELORO STELLITE DIV. OF DELORO SMELTING & REFINING CO. LTD. BELLEVILLE · ONTARIO · CANADA

AD. No. 265

*A welder at work on the upper portion of an 18,000-gallon oil-tank for impulse-testing of insulation.*

# Reyrolle welding-sets

**300/200-ampere AC/DC single-operator type-B welding generator set with concentric dual control.**

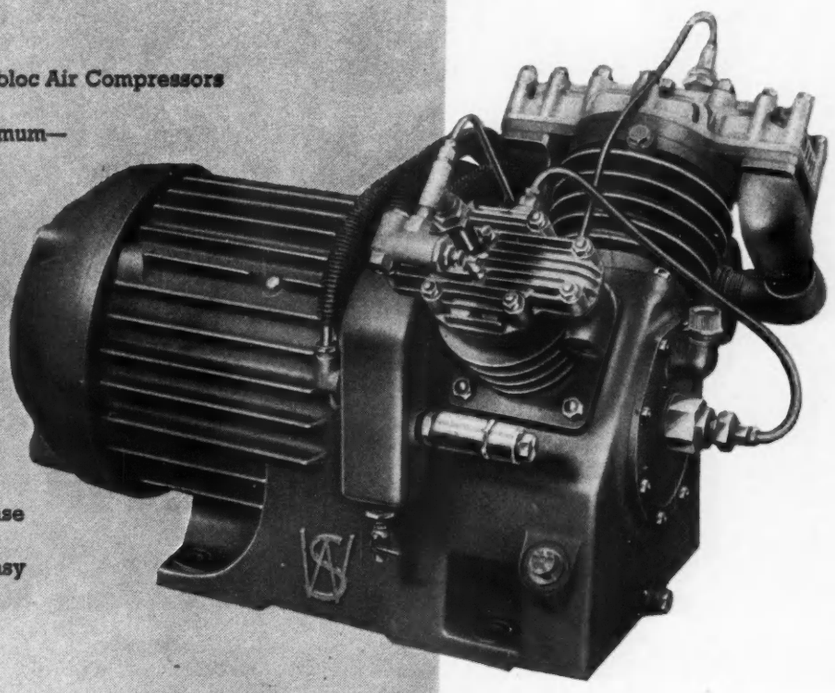


**Reyrolle**

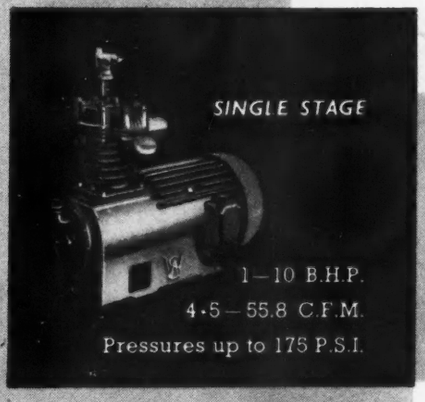
A. REYROLLE & COMPANY LIMITED • HEBBURN • COUNTY DURHAM • ENGLAND

# compressed air *with less wear*

The use of a single shaft in Monobloc Air Compressors reduces working parts to a minimum— no belts, pulleys or couplings— and ensures perfect alignment at all times. Power consumption is reduced by cutting mechanical losses and air friction to a minimum. The unit construction with integral base ensures space economy and easy installation.

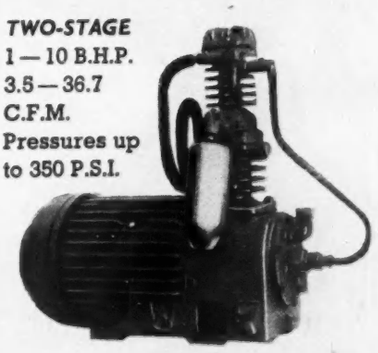


## *NEW* MONOBLOC *COMPRESSORS GIVE COST-SAVING ADVANTAGES*




- ✻ TOTALLY ENCLOSED MOTOR
- ✻ ONE SHAFT PERMANENT ALIGNMENT
- ✻ SIMPLER INSTALLATION — NO BELTS, PULLEYS OR COUPLINGS
- ✻ LOW FIRST COST — LITTLE MAINTENANCE COST
- ✻ LOW POWER CONSUMPTION

*TWO-STAGE*
1—10 B.H.P.
3.5—36.7
C.F.M.
Pressures up to 350 P.S.I.

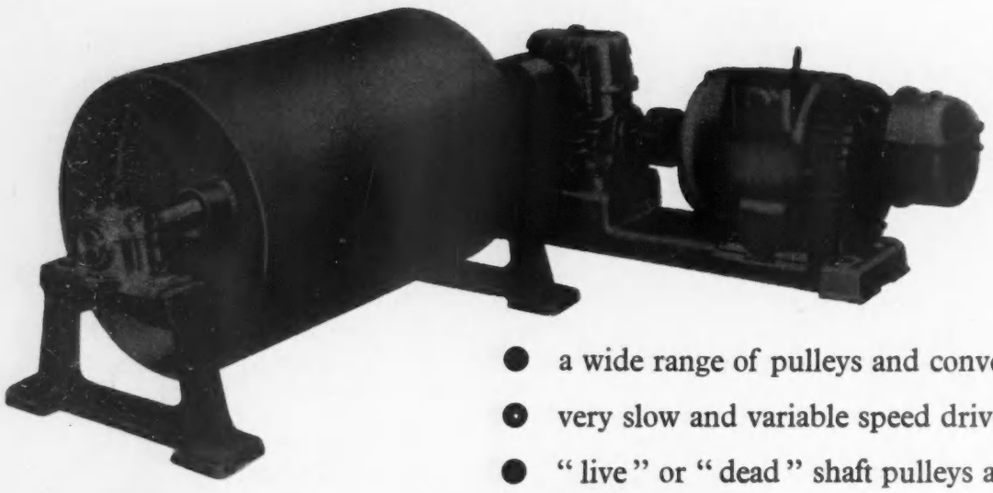


# Worthington-Simpson LTD NEWARK NOTTS

# conv dr

## CROFTS MAKE THE
## CROFTS (ENGINEERS) LIMITED

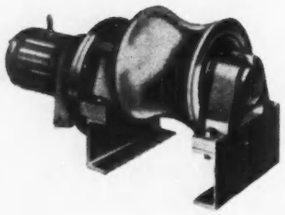
### CROFTS CONVEYOR DRIVE ASSEMBLIES
### FOR EVERY POSSIBLE APPLICATION



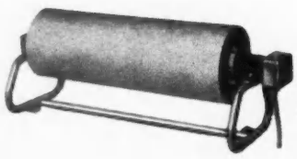
*publication* 853

- a wide range of pulleys and conveyor belt drives built to order
- very slow and variable speed drives a speciality
- "live" or "dead" shaft pulleys and idlers

*Plummer Blocks plain, ball or roller bearings Publication* 5734



*Motor Rollers Publication* 5414



*Motorised Conveyor Pulleys Publication* 5745

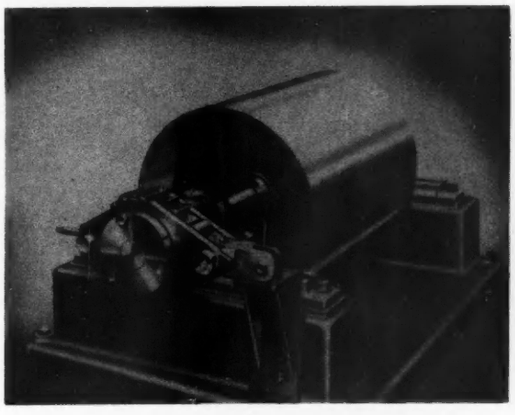
**CROFTS (ENGINEERS) LIMITED**
POWER TRANSMISSION ENGINEERS
*Head Office:* Thornbury · Bradford 3 · Yorkshire
*Telephone:* 65251 (20 lines) *Telegrams:* "Crofters, Bradford Telex", Telex 51186

**Branches at:**
*Belfast · Birmingham · Bristol · Cardiff · Dublin Glasgow · Leeds · Liverpool · London . Manchester Newcastle · Northampton · Nottingham · Sheffield Stoke-on-Trent.*
***Representation throughout the world.***

# eyor ives

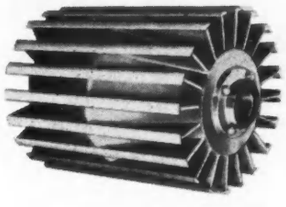
## FINEST YOU CAN BUY!
## POWER TRANSMISSION ENGINEERS

### CROFTS SILENT RATCHET BACKSTOPS
FOR BELT CONVEYORS



- positive protection against run-back due to overload or power failure
- six sizes for torques up to 250,000 inch pounds

*Belt Saver Conveyor Pulleys Publication* 5715



*Cast Iron Conveyor Pulleys Publication* 5416

*Shaft Mounted Gear Units Publication* 157

**Makers of:**

*Clutches, Conveyor drives, Couplings of all types, Double helical gear units, Fabricated steelwork, Geared motors, Hydraulic couplings, Iron, steel and non-ferrous castings, Machine-cut gears of all types, Motorised rollers, Patent taper-flushbushes, Plummer blocks, Shaft-mounted gear units, Special Machinery drives, Spiral bevel gear units, Turbine gears, V-rope Drives, Variable speed drives, Worm reduction gears.*

**CROFTS (ENGINEERS) LIMITED**
POWER TRANSMISSION ENGINEERS
*Head Office:* Thornbury · Bradford 3 · Yorkshire
*Telephone:* 65251 (20 lines) *Telegrams:* "Crofters, Bradford Telex", Telex 51186

# *Summing up on the sliding-shoe pump*

Self-priming, high suction lift, constant capacity at varying heads, self-compensation for wear, accessibility, supreme simplicity... As you tick off these points, you make the case for the MEGATOR sliding-shoe pump. The only moving parts are the rotor and the three rubber-lined plastic shoes.

Handling most liquids, MEGATOR pumps will outwork and outlast any other. You certainly should find out more about them.

MEGATOR

**SOME MEGATOR FACTS**

***High suction lift*** *permits installation in convenient positions.*

***Self-priming*** *inherent without any added device.*

***"Snoring"*** *ability sucks out the last drop.*

***Constant capacity*** *at varying pressures.*

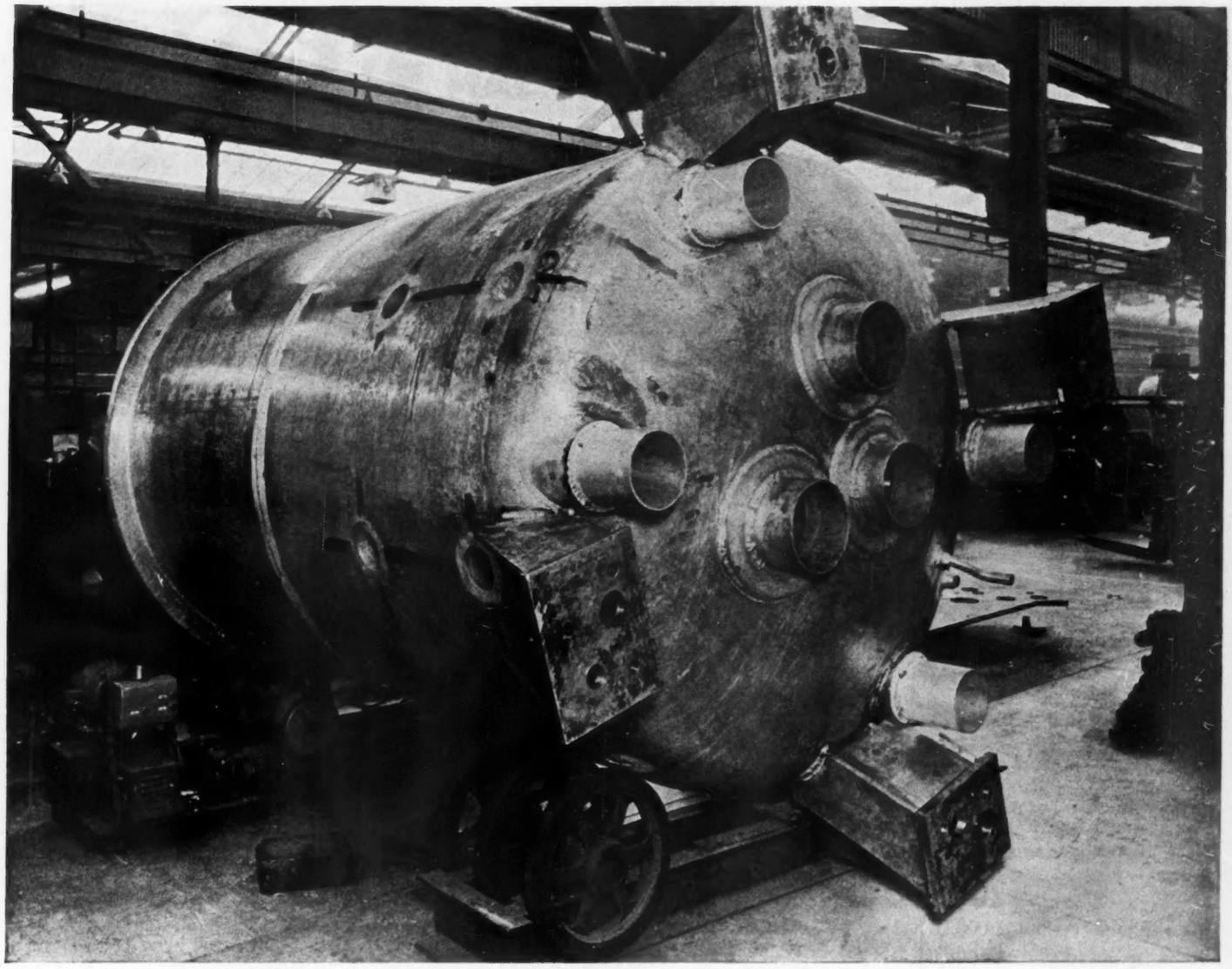
***Sustained performance*** *Self-compensating for wear.*

***Simple*** *Designed for easy maintenance.*

***Capacities*** *from 4 to 250 galls. per min.*

**MEGATOR PUMPS & COMPRESSORS LTD · 43 BERKELEY SQUARE · LONDON · W1 · Telephone: GROsvenor 6946**

TGA M107



# British Aluminium
# in the Atomic Energy field

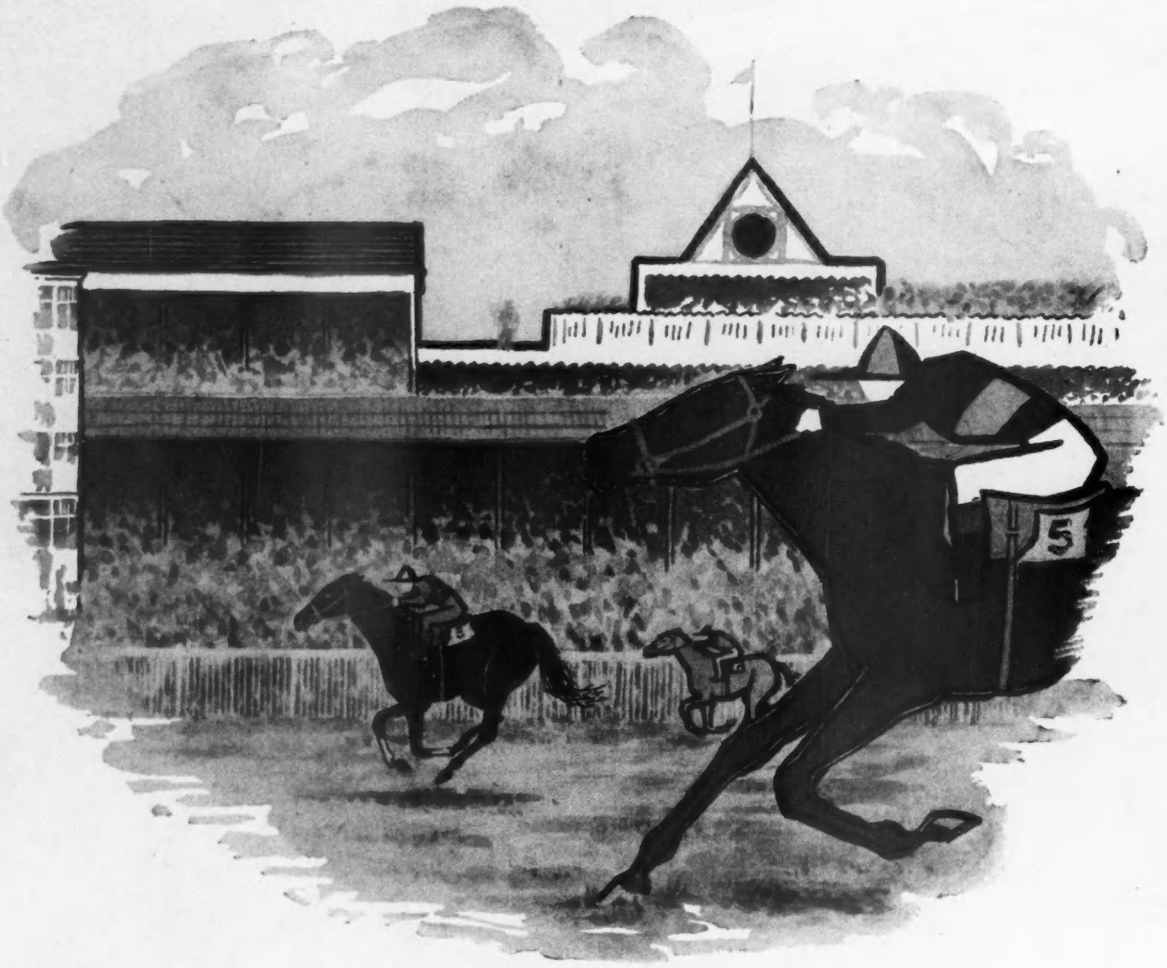
This "DIDO" Reactor Core Tank which contains the aluminium clad fuel elements and the heavy water moderator, is constructed from 99.8% purity aluminium. It was fabricated by The A.P.V. Co. Ltd., to the order of Head Wrightson Processes and is one of four being built for installation in research reactors to be used by the British and Australian Atomic Energy Authorities for high flux testing and the production of radio-isotopes.

## The BRITISH ALUMINIUM Co Ltd

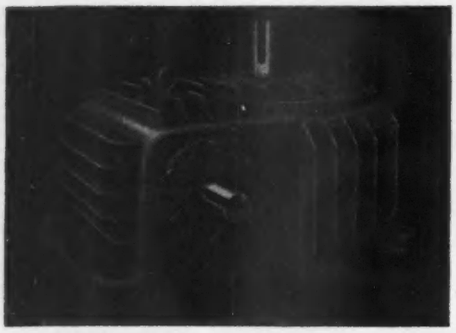
NORFOLK HOUSE ST JAMES'S SQUARE LONDON SW1

AP51

P




# What happens at Newbury



*Single Reduction Fan Cooled Worm Gear Units. Vertical output shaft. For transmitting powers up to 110 h.p. Ratios 3:1 to 100:1.*

***Ingenuity, backed by technical "know how" enabled the famous Racecourse at Newbury to become one of the most popular racing centres in the country—famed for its first-class amenities, efficient appointments and its constant attention to the well-being of its many patrons.***

**Although we at Oppermans offer no Gold Cup, we do offer all the skill, resources and technical "know how" acquired in our many years in the Gear industry. These facilities are at your disposal—we do hope that you will make use of them by sending your enquiries to Oppermans of Newbury.**

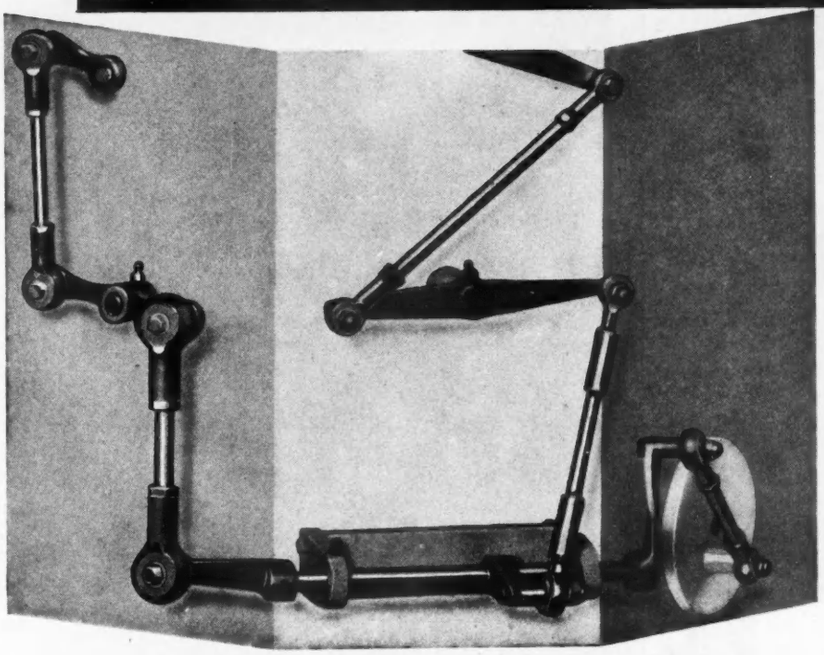
# OPPERMANS OF NEWBURY

**OPPERMAN GEARS LTD · NEWBURY · BERKSHIRE** *Tel:* Newbury 1701 · *Telegrams:* Oppigears, Newbury

**ROSE**

*FOR THE CORRECTION OF*
**MAL-ALIGNMENT**
*with*
*ECONOMY · EFFICIENCY · DEPENDABILITY*

**SELF ALIGNING SPHERICAL BEARINGS & SPHERICAL BEARING ROD ENDS**
*by* **HEIM & ROSE**



*A.I.D., A.R.B. approved*

**"HEIM AND ROSE WILL CARRY THE LOAD":** Catalogues and Technical Information from
**ROSE BROTHERS (Gainsborough) LTD.**
Phone: Gainsborough 2231 (8 lines) **Bearings Division, GAINSBOROUGH, Lincs.** Grams: Rose, Gainsborough, Telex (Telex 56-145)

The Engineer

# BUYERS GUIDE

## 1958

**Now Available**

**CONTENTS**

Associations, Institutions and Societies connected with the Engineering Industry.

Address Section.

U.K. Agents for Foreign Firms.

Trade Names.

**Buyers Guide.**
32,000 Suppliers' entries under 2,300 product headings.

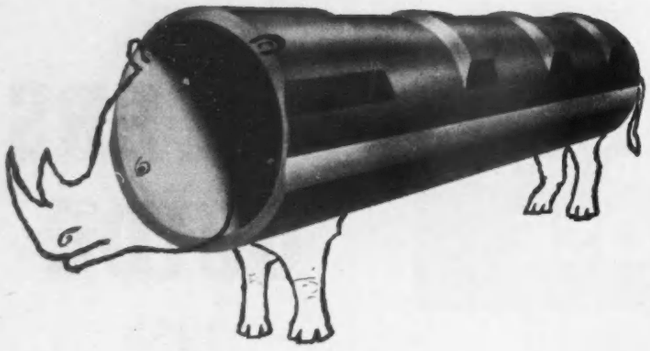
Forthcoming Engineering & Industrial Exhibitions.

One free copy has been sent to every postal subscriber to 'THE ENGINEER' and every regular reader who buys his copy from a newsagent.

A copy has also been sent to each advertiser in 'THE ENGINEER' and the BUYERS GUIDE itself.

Additional copies obtainable at 7/6 each (plus postage 1/9) from :—

**The Manager—**
**THE ENGINEER**
28, ESSEX STREET, STRAND,
LONDON, W.C.2
CENtral 6565



Dash it all—I've fairly
peppered the brute
and every shot bounces off!

**Perhaps a twenty-five pounder
is called for.**

Doubt whether
that would do either.
Haven't you noticed . . .

**By jove! *Seamless* steel.
Not a weld or
a weak spot anywhere!**

Quite. Let's creep quietly away,
old man, before *it* notices *us*.

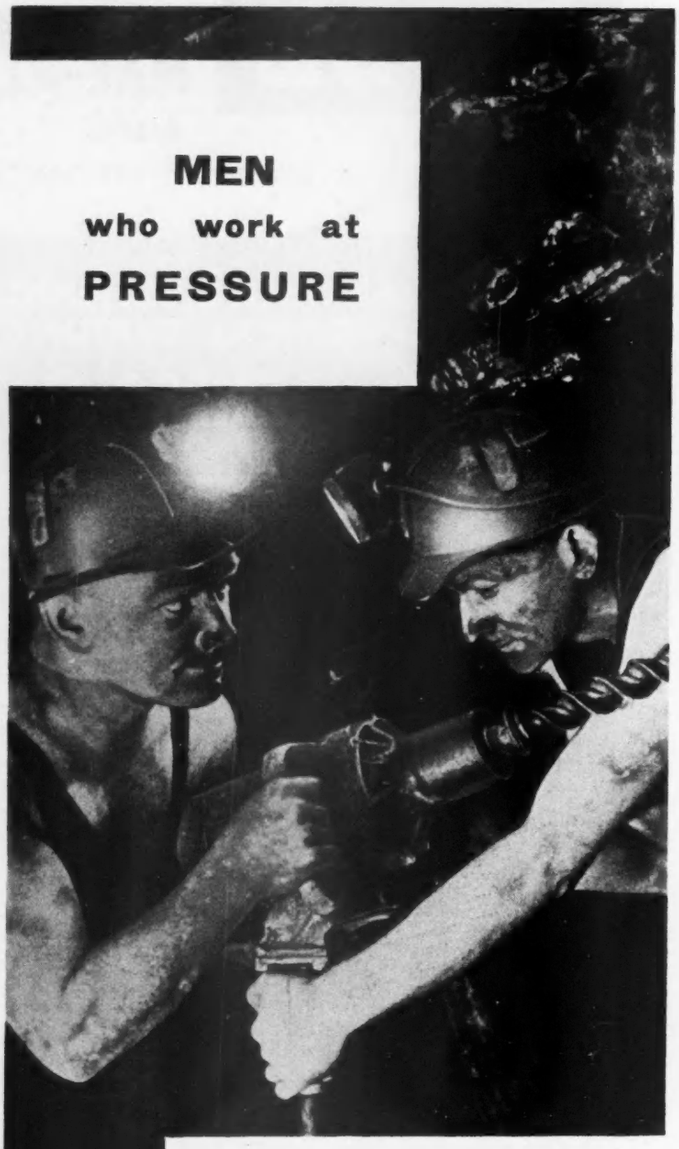
**Chesterfield Tubes**

*The marine boiler drum illustrated was machined externally to form tube and wrapper plates and pads. It is 14 ft. 6 ins long and has an internal diameter of 30 ins. Tubes of this calibre we take in our stride; in fact, we're game for any size you want.*

THE BIG GAME OF THE TI GROUP

THE CHESTERFIELD TUBE COMPANY LIMITED · CHESTERFIELD · ENGLAND
CRC 50

**MEN**
**who work at**
**PRESSURE**



**. . . know the value of reliable and accurate**

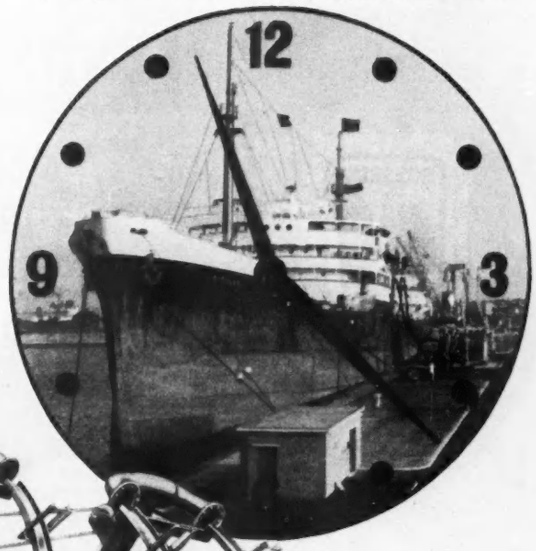
# VALVES

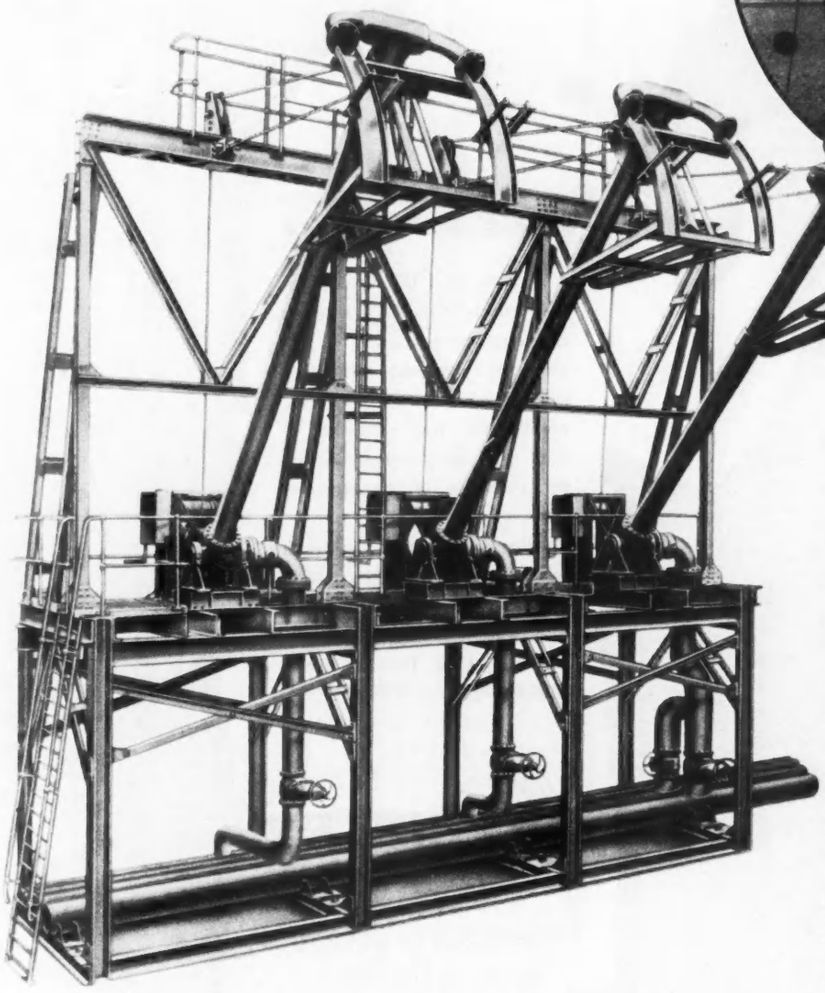
Automatic plate and disc valves are our particular concern. It's astonishing how many different versions of these vital components we have produced in the last seventy years. Our experience is unique—and is at your service.

***Your** valve problems are **our** business*

THE
**METALLIC VALVE**
COMPANY LIMITED
117/125 BRIDGE ST., BIRKENHEAD, CHES. PHONE: BIRKENHEAD 8961/2

# FOR A QUICKER TURN ROUND



In these days of high shipping costs and dock dues, not to mention the importance of fuel oil to our economy, swift loading and unloading at the dockside is of paramount importance.

John Smith Hose Handling Derricks are expressly designed for the speedy ship-to-shore unloading of crude oil from incoming tankers in this country, and for the swift loading of outgoing tankers at Middle Eastern ports. The upper illustration shows a John Smith installation at Queen Elizabeth II Dock, Eastham, while the lower one is of one in use at Gosport, Hants.

## . . . use JOHN SMITH

## *Hose Handling Derricks*

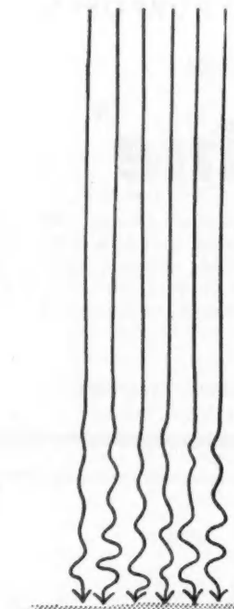
John Smith CRANES

**JOHN SMITH (KEIGHLEY) LTD. P.O. BOX 21 THE CRANE WORKS · KEIGHLEY · YORKS**

**Telephone : Keighley 2283 (4 lines)** **Telegrams : Cranes, Keighley**

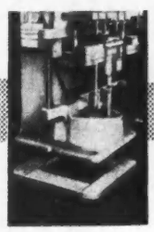
**London Office** : *Buckingham House, 19|21, Palace St., (off Victoria St.), London S.W.1. Telephone : Tate Gallery 0377|8*
**Southern Counties Office :** *Brettenham House, Lancaster Place, Strand, London W.C.2. Telephone : Temple Bar 1515*

HORSELEY
GROUP
Since 1770...
. . . the name of Horseley has been associated with major British engineering achievements.
The early pioneering spirit, evidenced by the construction of the world's first iron steamship in 1822, is as strong today in meeting the challenge of contemporary engineering problems.
The Horseley Group offers a wealth of experience, and extensive facilities to meet the most exacting demands of Constructional, Chemical, Civil, Gas and Water Engineering.
The HORSELEY Group
HORSELEY BRIDGE & THOMAS PIGGOTT LTD
TIPTON • STAFFS
Telephone: Tipton 1104
MECHANS LIMITED
SCOTSTOUN IRON WORKS
GLASGOW
and Associated Companies
Also at
LONDON · SHEFFIELD
NEWCASTLE WADDON



## THERE'S A SOUND BARRIER IN INDUSTRY, TOO!

More than 1,000 factories now use the Croid-Cooper method to combat noise and vibration, the arch-enemies of efficiency. In these factories each machine is simply stuck down on a felt base with a holding power of 50lbs to the square inch, a felt base that absorbs more than 80% of vertical vibration in some cases, reducing the wear on machines and enabling them to produce more accurate work. Reducing the wear on operators' nerves, too. With the Croid-Cooper method bolting and grouting are things of the past, and layouts can be changed overnight. Send for further details today.

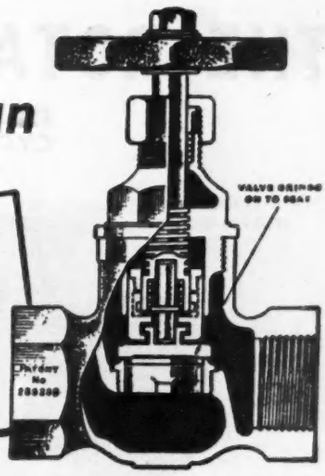


**CROID 65**
MACHINE FIXING GLUE
**COOPERS FELT**

COOPER & CO. (B'HAM) LTD.
BRYNMAWR, BRECONSHIRE
Telephone: BRYNMAWR 312

## Cheaper in the long run

The BRADFORD AUTO-GRIND




There's a very good reason why Bradford Auto Grind Valves are less expensive to maintain. They're so designed that, in closing, the valve seat is re-ground automatically.
This operation gives positive assurance of a completely pressure-tight seal every time the valve is closed. Thus the Auto Grind valve can be relied on for exceptionally long service.

*Send for details:*

## UNITED STATES METALLIC PACKING CO. LTD.

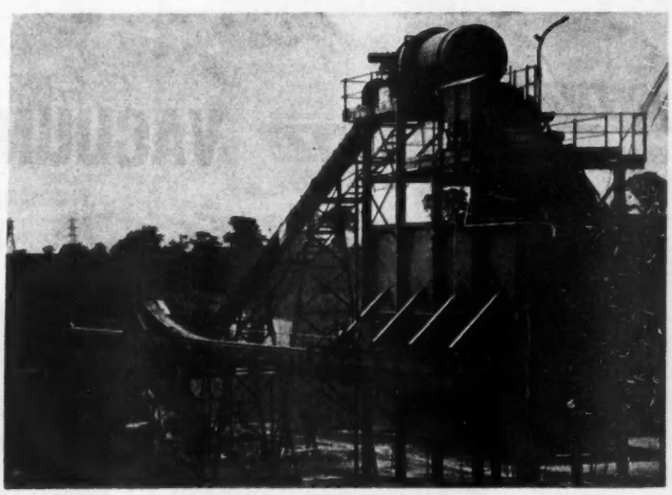
SOHO WORKS, BRADFORD 8, YORKSHIRE
Telephone: Bradford 41284-5 Telegrams: "Metallic"
*Branch Offices:* LONDON · LIVERPOOL · GLASGOW · MANCHESTER
NEWCASTLE · CARDIFF · SOUTHAMPTON · HULL · SWANSEA and BRISTOL

## DROPFORGINGS

DROP FORGED STEEL TURNBUCKLES
*Tapped Right and Left Hand Whitworth Threads.*

ARMSTRONG STEVENS AND SON LTD.
WILLENHALL STAFFS.

REGISTERED TRADE MARK



## SHOULD YOU BE CONSIDERING

the improvement of any part of your plant, ask us to come and be constructive about it.

We are experts in plant installation to suit site and conditions.

Your enquiry commits you to nothing, but our suggestions may well point the way to unexpected sources of profit and better output.

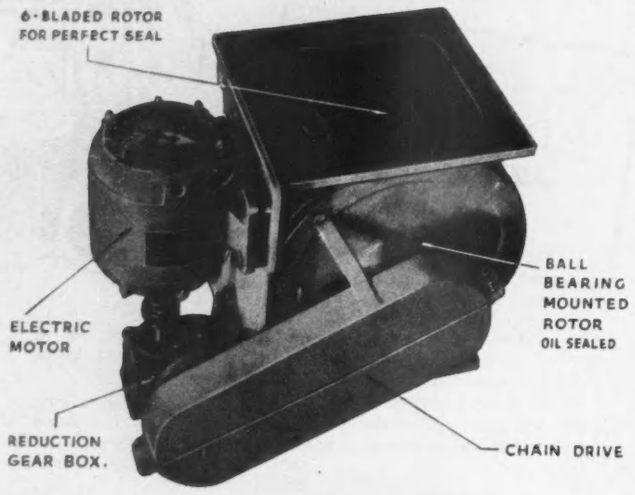
*CALL US IN WITHOUT OBLIGATION.*

**NIAGARA**
**SCREENS (Great Britain) Ltd.**
**STRAYSFIELD RD., CLAY HILL, ENFIELD, MIDDX.**
*Telephone: Enfield 6622 (4 lines)*

NIAGARA VIBRATORY SCREENS
AUTOMATIC FEEDERS
UNI-FLOW and CONTRA-FLOW WASHERS
CONVEYORS
ELEVATORS
*We design, manufacture and erect*

# THE ROTARY VALVE

**OR FEEDERS FOR CYCLONES AND BINS**




REDUCES DUST LOSSES

CAPACITIES UP TO 70 TONS PER HOUR

ELIMINATES FIRE RISK

TRADE SUPPLIED

WRITE FOR LEAFLET

**F. E. CALLOW**
(ENGINEERS) LIMITED
BIRCHILL RD. · KIRKBY TRADING ESTATE
LIVERPOOL · ENGLAND

Telephone: Simonswood 2461-2

**FOR MANY PRACTICAL PURPOSES**

*engineers use*

# "Plasticine"

*Reg'd Trade Mark*

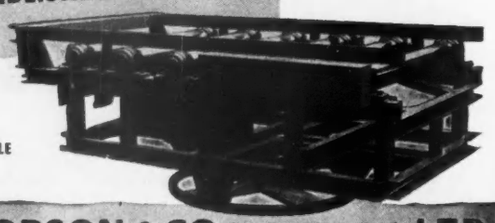
'Plasticine' has many important uses in engineering. Uses as wide apart as making experimental models and retrieving small parts which have fallen into a machine. 'Plasticine' is ductile, antiseptic, watertight, stable in character, and it adheres quite easily to metal. It is ideal for sealing and for holding irregular objects in position. Every engineer should have 'Plasticine' at hand. For more detailed information on its uses write to:—

**HARBUTT'S PLASTICINE LTD. (Dept. E), BATHAMPTON, BATH, SOMERSET**

*Harbutt's were the inventors and remain the sole makers of 'Plasticine'*

# ROBSON CONVEYORS

**ESTABLISHED 1906**



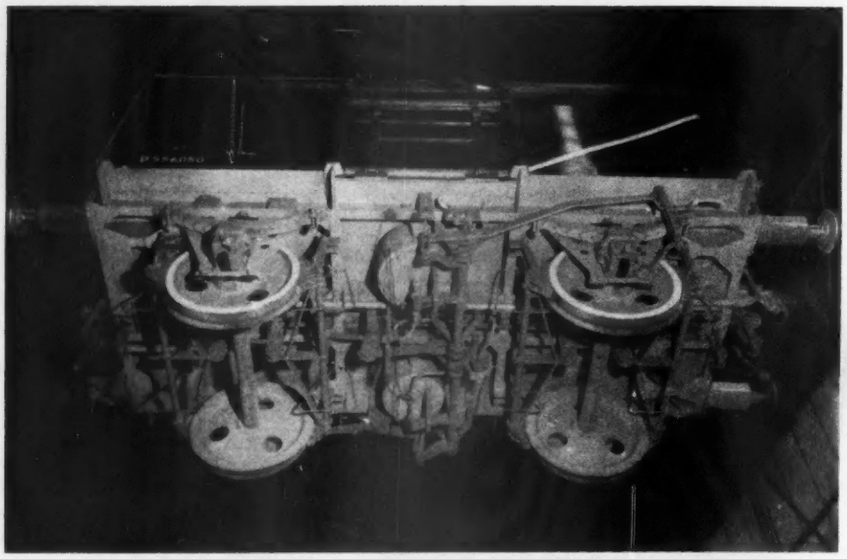

**Geo. ROBSON & CO. (CONVEYORS) LTD.**
HODGSON STREET · SHEFFIELD.
*PHONE.* SHEFFIELD. 27463/4

METRO-CAMMELL

# VACUUM-BRAKED WAGONS

*SPEED* **THE MODERNISATION PLAN**

**Regular deliveries to British Railways of Vacuum-Braked 16-ton Mineral Wagons are now being made from METRO-CAMMELL'S Old Park Works**



**METROPOLITAN–CAMMELL CARRIAGE & WAGON CO. LTD.,**

HEAD OFFICE: SALTLEY BIRMINGHAM LONDON OFFICE: VICKERS HOUSE · BROADWAY · WESTMINSTER S.W.1

# for accurate measurement choose

# *NEGRETTI & ZAMBRA*

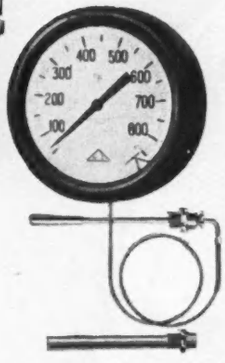
# precision-made Thermometers

Dipping Thermometer
for hot water, etc.

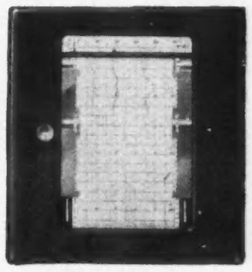
Room Thermometer
with plastic case

Brass-cased Tank and
Pipe Thermometer

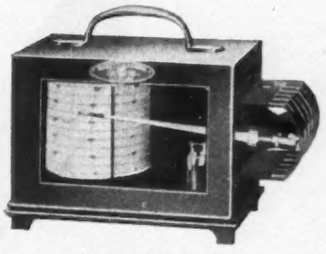
4" Mercury-in-steel
Dial Thermometer,
Rigid Stem Type



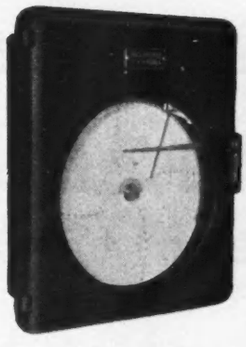
Distance-type Mercury-in-
steel Dial Thermometer



Resistance Thermometer
Recorder



Bi-metallic Recording
Thermometer



Mercury-in-steel Disc
Chart Recorder

Multi-point Indicator
Pyrometer

For complete technical literature about
Thermometers write to:—

## *NEGRETTI & ZAMBRA*

NEGRETTI & ZAMBRA LTD., 122 REGENT STREET, LONDON, W.1.

*Telephone: REGent 3406* *Telegrams: NEGRETTI PICCY LONDON*

Branches at: Birmingham, Cardiff, Glasgow, Manchester, Leeds,
Nottingham. Agents or subsidiaries in most countries.

The first Crompton Parkinson self-regulating alternators with 'Magnicon' excitation have now many years service to their credit. As news they are dead: as alternators, still very much alive.

What is new — and still live and exciting news — is the upward extension of the range: the latest Crompton Parkinson 'Magnicon' excited alternators are available with outputs up to 350 kVA.

The full range of Crompton Parkinson alternators extends up to 1500 kVA — and all have the benefit of manufacturing experience that goes back to the earliest days of electric power generation.

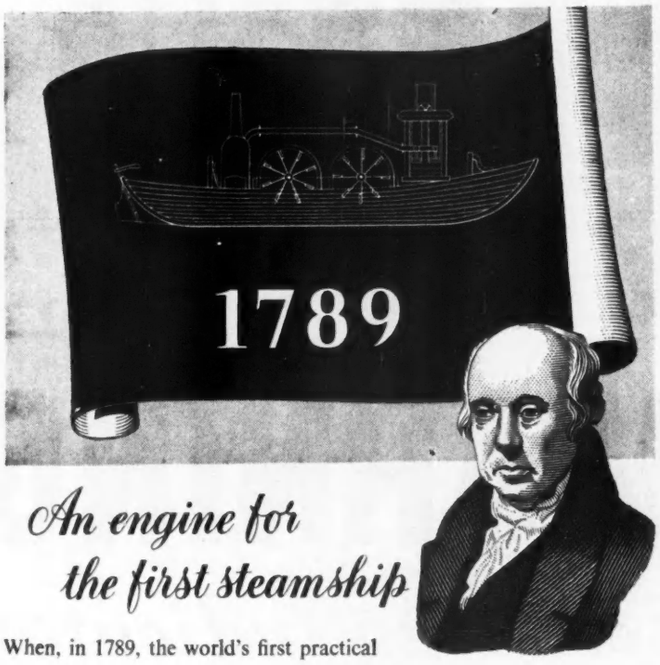
**Crompton Parkinson** LIMITED

*Member of the Nuclear Power Consortium:*
**ATOMIC POWER CONSTRUCTIONS LTD.**

MAKERS OF ELECTRIC MOTORS OF ALL KINDS · INSTRUMENTS
ALTERNATORS AND GENERATORS · SWITCHGEAR
B.E.T. TRANSFORMERS · CABLES · CEILING FANS
LAMPS · LIGHTING EQUIPMENT · BATTERIES
STUD WELDING EQUIPMENT · TRACTION EQUIPMENT

CP ELECTRICAL EQUIPMENT

**CROMPTON PARKINSON LIMITED, CROMPTON HOUSE, ALDWYCH, LONDON, W.C.2**




## *An engine for the first steamship*

When, in 1789, the world's first practical steamship had her trials on the Forth and Clyde Canal, the results were most satisfactory. Built under the supervision of William Symington—"the father of marine engineering"—the vessel was powered by engines built by Carron Company, and these were an unqualified success. Then, as now, it paid men with ideas to get in touch with Carron Company.

# 1958

# CARRON

## *engineering for all industries!*

Although Carron Company to-day is a highly technical, efficient organisation, the old pride in craftsmanship, which has been the basis of its success, is more than ever in evidence. This is why the top men in all branches of industry—shipbuilding, marine and general engineering, catering, public works, heating and lighting and Government Departments—discuss their problems with Carron Company's advisory service. They unfailingly gain benefit from this—and so will you!

**CARRON COMPANY · CARRON · FALKIRK · STIRLINGSHIRE**

Showrooms and Sub-Offices: 15 Upper Thames Street, London, E.C.4. 22-26 Redcross Street, Liverpool, 1. 125 Buchanan Street, Glasgow, C.1. Sub-Office: 33 Bath Lane, Newcastle upon Tyne.

E.5B

# P.&W.MACLELLAN, LTD

CLUTHA WORKS
35 MACLELLAN STREET
GLASGOW S.1

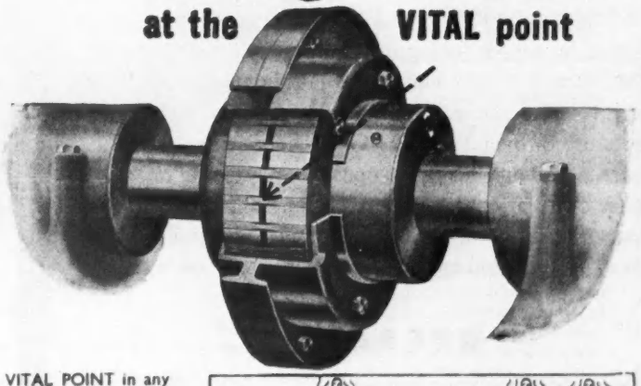
STEEL BRIDGES
STEEL FRAMED BUILDINGS
STEEL RAILWAY WAGONS
TANKS
ELECTRIC WELDING
HYDRAULIC PRESSINGS
FORGINGS AND DROP STAMPINGS
RAILWAY AND GENERAL ENGINEERING

**Telephone:** IBROX 1135 (4 lines)

**Telegrams:** "MACLELLAN GLASGOW"

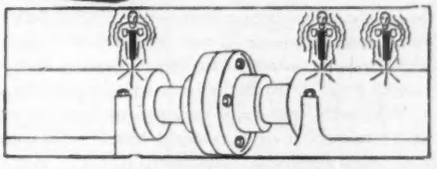
# *safeguarded!*

## at the VITAL point

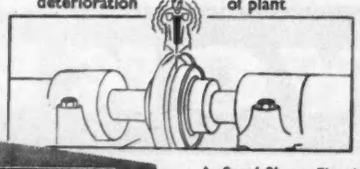


THE VITAL POINT in any power plant is where the shaft of the driving unit links up with the shaft of the unit driven. Vibration, shocks and stresses resulting from misalignment at this point are reflected in loss of power and, eventually, by serious breakdowns.

You can safeguard your plant by fitting Steel-Shaw flexible couplings between units. Steel-Shaw couplings counter misalignment, absorb vibration, and assure cheaper running and better performances.



Unless checked accumulative shocks and stresses passed from unit to unit will result in rapid deterioration of plant



**The STEEL-SHAW Flexible Coupling**

A Steel-Shaw Flexible Coupling absorbs shocks, reduces vibration, and smooths out irregularities of load and power between units.

*Write now for Illustrated brochure No. 1306/54*

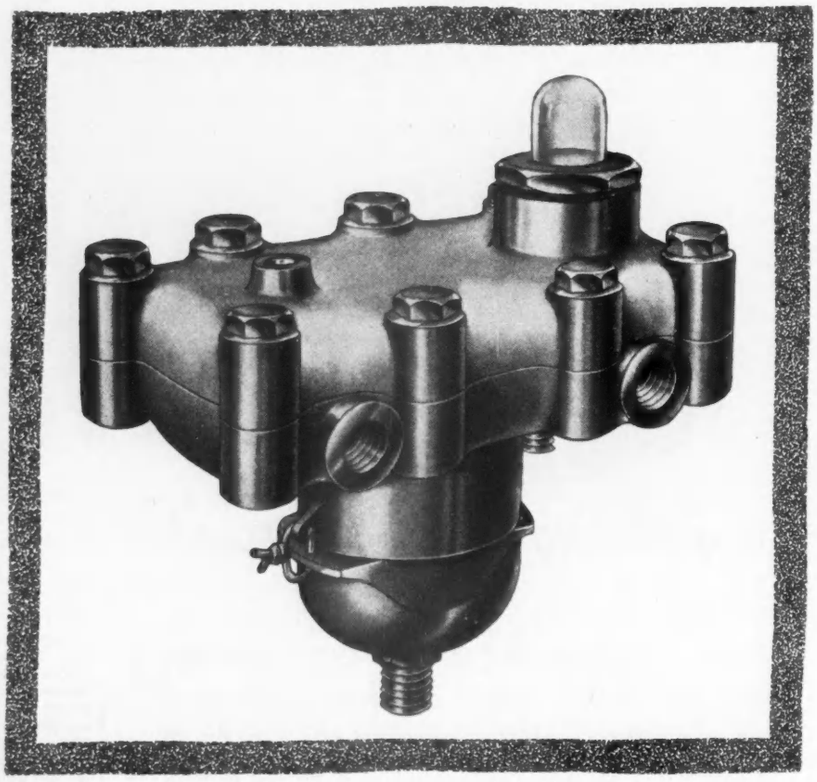
STEELE & COWLISHAW LTD., Dept 16, COOPER STREET, HANLEY, STOKE-ON-TRENT

3250

# NOW

# POSITIVE WARNING

## *With Vokes Filter Servicing Indicator*



Easily fitted to existing filters, the Vokes Filter Servicing Indicator is an inexpensive, mechanically operated unit. Fitted by copper tubing to the inlet and outlet sides of the filter, it clearly indicates when the filter element is approaching the recommended maximum differential pressure through the collection of contaminants. It can be adjusted and pre-set to operate over a wide range of filter differential pressures and is normally pre-set at the works to suit the application required. Full details of this new Vokes product will gladly be sent on request.

### OPERATION

The outer case incorporates a diaphragm dividing the case into high and low pressure compartments, each compartment being connected to the appropriate pressure side of the filter via capillary tubing. Any difference in pressure, and subsequent movement of the diaphragm, applies pressure to an overcentre snap-action spring giving magnified movement at one end. This actuates a vividly coloured thimble, which enters a transparent dome, and is immediately seen externally.

**VOKES** *Pioneers of Scientific Filtration*

**VOKES LIMITED • GUILDFORD • SURREY**

Telephone: Guildford 62861 (6 lines). Telegrams and Cables: Vokesacess, Guildford, Telex. Telex: 13-535 Vokesacess, Gfd.

*Vokes (Canada) Ltd., Toronto. Vokes Australia Pty. Ltd., Sydney. Represented throughout the World.*

V276

# attention to detail

Skill, experience and attention to detail during the design and manufacturing stages of HWP/Fluor Counterflo Cooling Towers, ensure that cooling can be guaranteed between prescribed limits, and that the Towers will function with the utmost efficiency and minimum attention for long periods.

FAN ASSEMBLY—A high efficiency, low speed, axial type, cooling tower air prime mover.

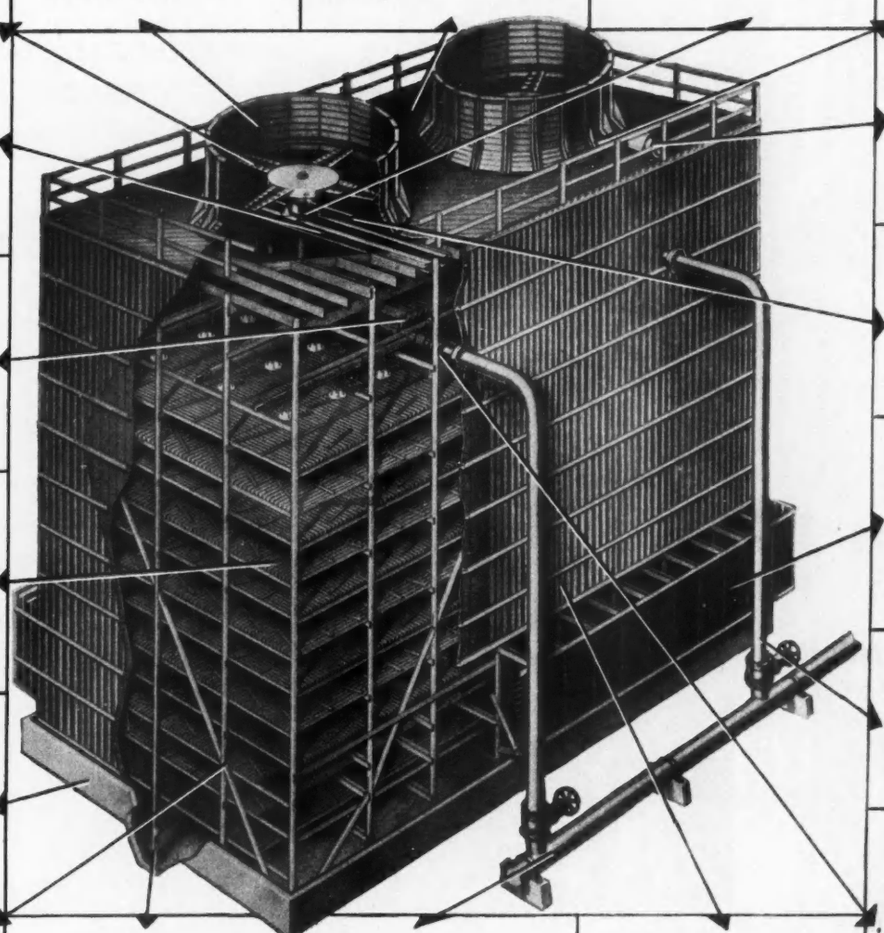
FAN STACK—Specially designed for trouble-free, vibrationless operation. Fabricated of seasoned redwood. Internal annular ring ensures maximum exhaust velocities.

FAN DECK—Diagonal decking, blocking and stress strips form a structural diaphragm which distributes live loads—wind, vibration—uniformly to all bracing.

SPEED REDUCER—A device for reducing fan driver speed to fan operating speed. May be single or double reduction gear or hydraulic motor.

VIBRATION CUT-OUT SWITCH—In case of excessive vibration of mechanical assembly, automatically shuts down fan driver.

SUPPORT FOR DRIVER AND SPEED REDUCER—Structural unit support for driver and speed reducer.



FAN DRIVER—A prime mover for fan service that may be an electric motor, gas turbine, steam turbine, or hydraulic motor.

DRIFT ELIMINATORS—A multi-pass baffle section constructed to minimize the entrained water in exit air stream.

DRIVE SHAFT—Floating shaft and flexible coupling assembly for transmitting power from driver to gearbox.

TOWER FILLING—Grid Decks or filling to provide maximum and continuous water break-up with a minimum of obstruction to flow of cooling air.

LOUVRES—Set three feet out from side, yet require no greater basin dimensions. Air is drawn into tower with less pressure drop. Icing problem formerly associated with louvres adjacent to tower columns eliminated.

BASIN—This collects the tower water and provides structural support for tower.

RISER—That vertical connector pipe between the manifold and cooling tower header.

WATER DISTRIBUTION SYSTEM—Completely non-corrosive . . . header and laterals of redwood stave construction banded with stainless steel . . . nozzles of porcelain (and stainless steel) or plastic. Headers and laterals are provided with cleanout valves and plugs for flushing during tower operation.

STRUCTURAL FRAMING—Redwood columns, braces, and chords, through bolted, utilizing connector plates.

BASE CASTING—A cast footing provided to ensure a uniform and solid connection between the tower columns and the basin pads.

MANIFOLD HEADER—A hot water pipe manifold distributing water to individual risers and cells.

SHEATHING—A tower sheathing designed for architectural beauty and positive elimination of leaks.

*Head Wrightson Processes design, manufacture and erect prefabricated timber and precast concrete Induced Draught Cooling Towers for all purposes. It will pay you to consult them on your own cooling problems.*

## HEAD WRIGHTSON PROCESSES LTD

TEESDALE HOUSE · 24/26 BALTIC STREET · LONDON · EC1

*OFFICES AT:* P.O. Box 1595 **SYDNEY** · P.O. Box 1034 **JOHANNESBURG** · P.O. Box 2608 **CALCUTTA** and 603 Royal Bank Buildings **TORONTO 1**

*Associates in the U.S.A.:* The Fluor Products Company · Los Angeles · New York · Chicago · Tulsa etc.

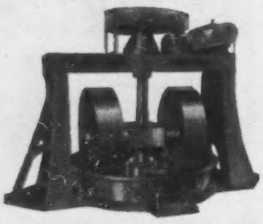
P.917

**TWIN DISC**
CLUTCHES AND HYDRAULIC DRIVES
AND
MARINE GEARS

BRITISH TWIN DISC
LIMITED

16-18 HENEAGE STREET,
LONDON, E.1

TRADE Smedley MARK
PAN GRINDING MILLS



REVOLVING OR STATIONARY PANS
PERFORATED OR SOLID BOTTOMS
OVER OR UNDER DRIVEN

Smedley Brothers. Ltd.,
Belper. Derbyshire.
Telephone: Belper 12

**BRITISH SPRINGS AND WASHERS**

B S & W

WILLIAM FINUCANE
(Springs and Pressings)
LTD.

A.I.D. A.R.B.

**ELGAR 3757/8/9**
16A, HILLSIDE, STONEBRIDGE
PARK, LONDON, N.W.10

**BRETT**
**DROP FORGING EQUIPMENT**

BRETT'S PATENT LIFTER Co LTD
FOLESHILL WORKS, COVENTRY

**SHEET METAL WORK & ENGINEERING FOR *EVERY INDUSTRY**

For many years we have enjoyed a reputation for work of the highest quality and precision finish. Our spacious workshops house some of the most up-to-date metal working machinery and our resources are available to those who require prototypes or pilot runs as well as to those whose demand is for quantity production.

***AUTOMOBILE**
Body panels, wings, cabs, silencers, petro tanks, etc., etc.

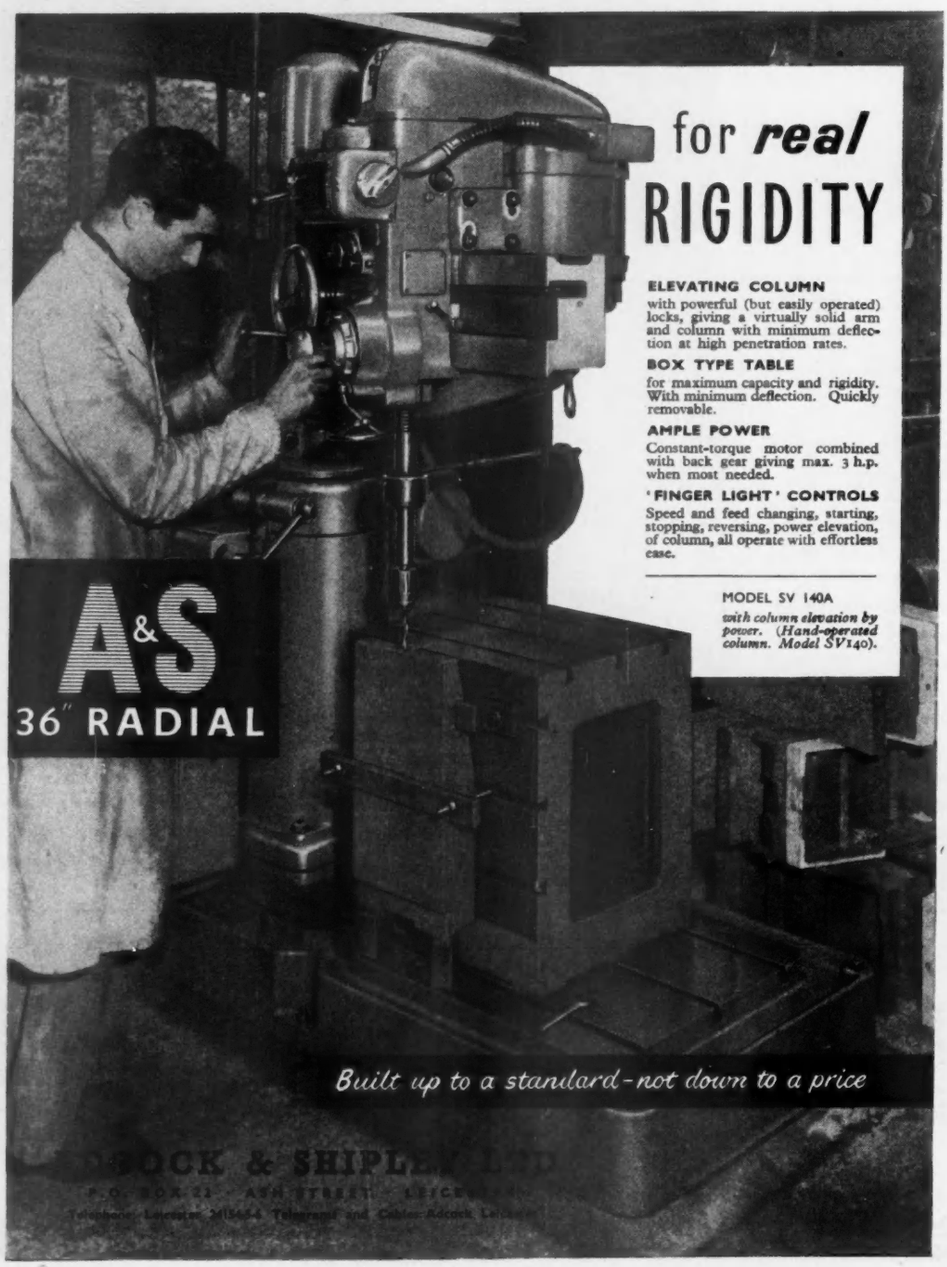
***ELECTRONICS**
Main control cabinets, instrument panels and boxes, receiver chassis, etc.

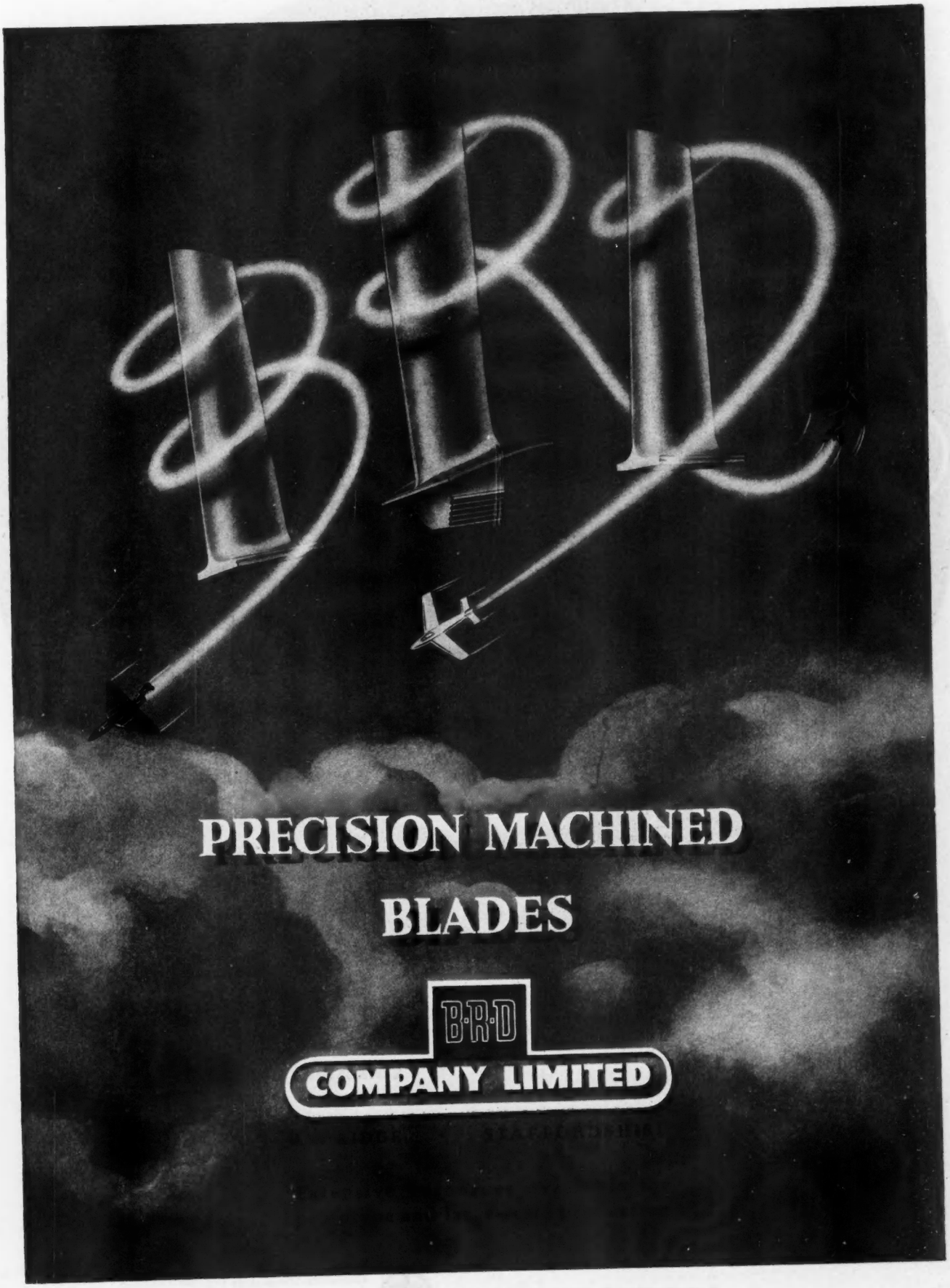
***AIRCRAFT**
Fuel tanks, elevators, tail planes, pressings, fabrications in all metals.

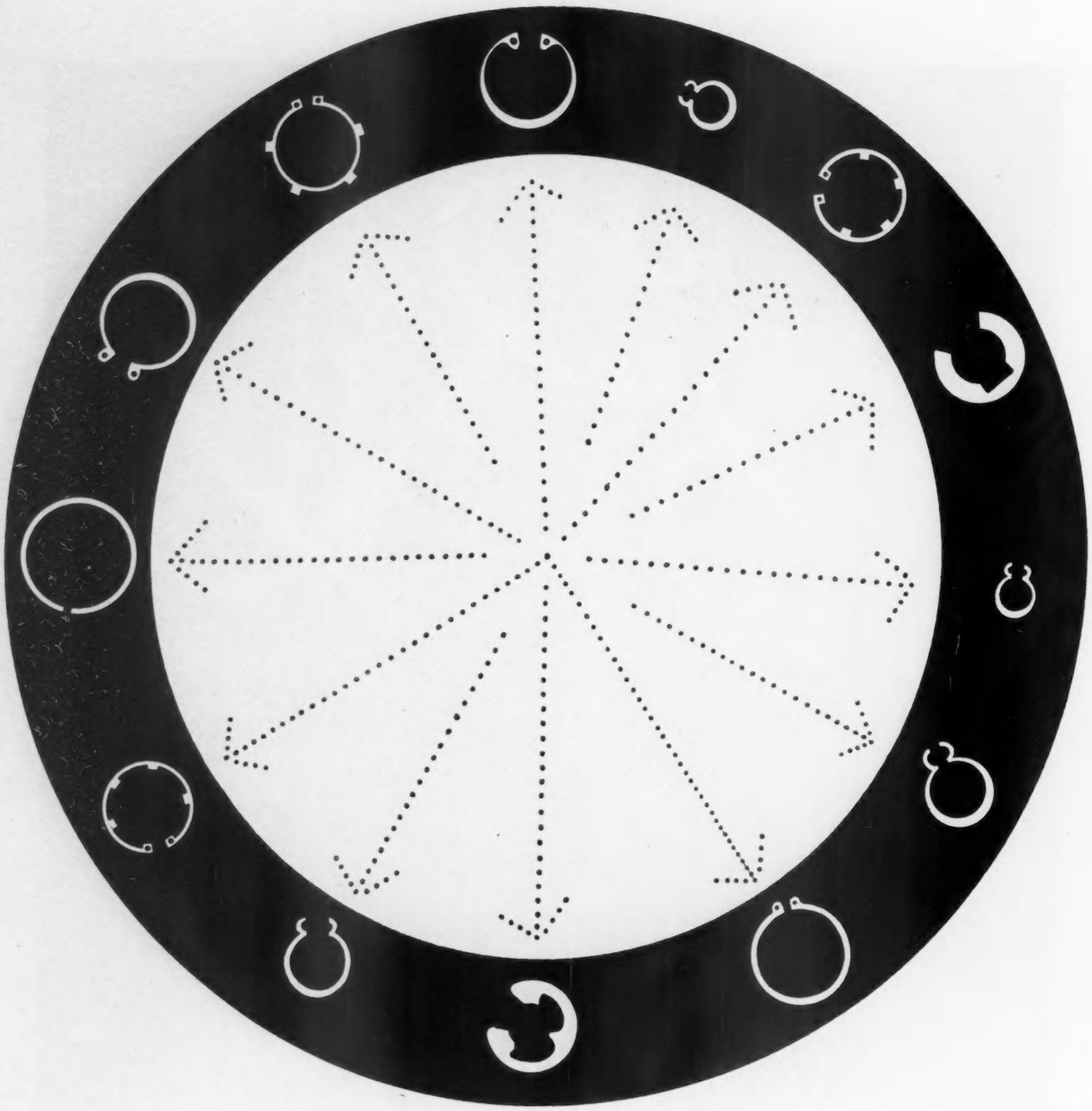
*Our Sheet Metal Working Plant includes:*
Presses up to 200 tons, Guillotines, Wiring Machines, Press Brakes, Benders, Riveting and all types of Welding and General Engineering Plant.

E.G. Brown & Co Ltd

WEST ROAD, TOTTENHAM,
LONDON, N.17
*Telephone: TOTtenham 2257-8-9*


for real
RIGIDITY
ELEVATING COLUMN
with powerful (but easily operated) locks, giving a virtually solid arm and column with minimum deflection at high penetration rates.
BOX TYPE TABLE
for maximum capacity and rigidity. With minimum deflection. Quickly removable.
AMPLE POWER
Constant-torque motor combined with back gear giving max. 3 h.p. when most needed.
'FINGER LIGHT' CONTROLS
Speed and feed changing, starting, stopping, reversing, power elevation, of column, all operate with effortless ease.
MODEL SV 140A
with column elevation by power. (Hand-operated column. Model SV140).
A&S
36" RADIAL
Built up to a standard-not down to a price


B·R·D
PRECISION MACHINED
BLADES
B·R·D
COMPANY LIMITED

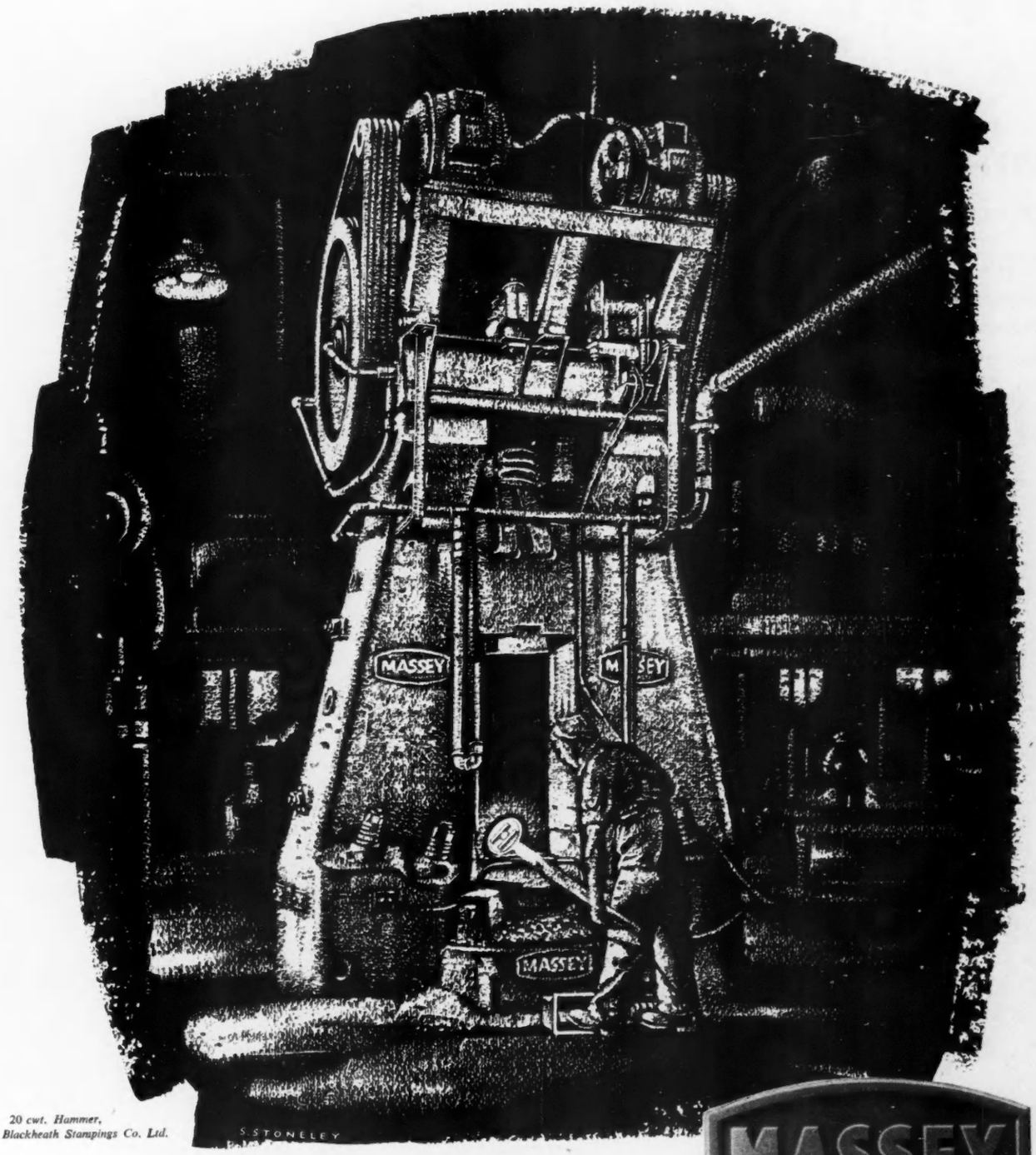


- **360° safe**
- **Consistent dimensions**
- **Constant pressure**
- **A vast range of sizes**

*That's why more people choose* **SEEGER CIRCLIPS** *than any other make*

**Automotive Engineering Limited**

One of the Sheepbridge Engineering Group
**The Green, Twickenham, Middlesex.**
Telephone: Popesgrove 2206/9. Telegrams: Motif, Twickenham.




*20 cwt. Hammer, Blackheath Stampings Co. Ltd.*

MASSEY

# *cut costs with . . .*

Massey Marathon Hammers are specially designed for mass production forging. They are made in sizes from 10 cwt. to 40 cwt. and being electrically driven the running costs are low: the insulation of the lifter from shock ensures low upkeep costs and the design of the slides and standards makes it possible to work to close limits.

***Massey designs include:—***

*Steam and Compressed Air Hammers, Pneumatic Power Hammers, Friction Drop Hammers, Double-acting Steam and Compressed Air Drop Hammers, Forging Presses, Trimming Presses, Tyre Fixing Rolls.*

**B. & S. MASSEY LTD. · OPENSHAW · MANCHESTER · ENGLAND**

**MAKERS OF THE WORLD'S GREATEST RANGE OF FORGING PLANT**

# DONOVAN

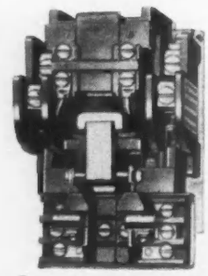
## A.C. POWER RELAYS

## WITH 2, 4 OR 8 POLES

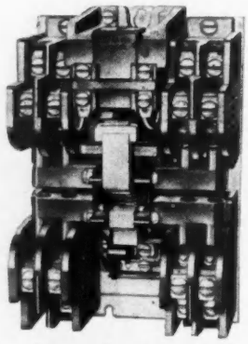
Any pole can be supplied "Normally-open" or "Normally-closed"; double-break main contacts rated at 10 amps., 550 volts maximum. One or two auxiliary change-over contacts can be added in addition to main poles. Tractive coils available—6 to 550 volts A.C.

The relay, when open style, is supplied with back fixing plate suitable for mounting on insulation or steel panels, or in metal cases.

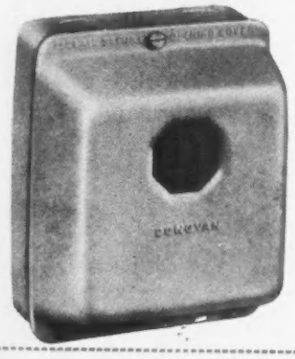
*Further details on request.*



● 2-pole Open Style Relay with two change-over coil circuit contacts.



● 8-pole Open Style Relay with one change-over coil circuit contact.



● 4-pole Enclosed Relay.

**THE DONOVAN ELECTRICAL CO. LTD.**

71 GRANVILLE ST. - BIRMINGHAM, 1

LONDON DEPOT: 149-151 YORK WAY, N.7
GLASGOW DEPOT. 22 PITT STREET, C.2

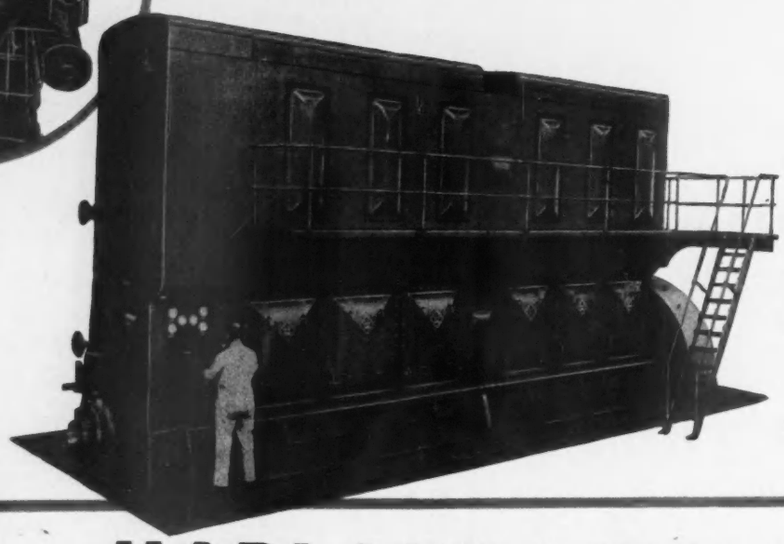
*Sales Engineers available in:—*

LONDON, GLASGOW,
BIRMINGHAM, BELFAST,
MANCHESTER, BOURNEMOUTH.

# H&W

2-STROKE
OPPOSED-PISTON
ECCENTRIC TYPE

## Oil Engines



**AVAILABLE IN POWERS UP TO 6,000 B.H.P.**

**turbo-charged with air-cooling, resulting in greater output and reduced fuel consumption**

*One of eleven 6-cyl. engines ordered by the Iraq Petroleum Company.*

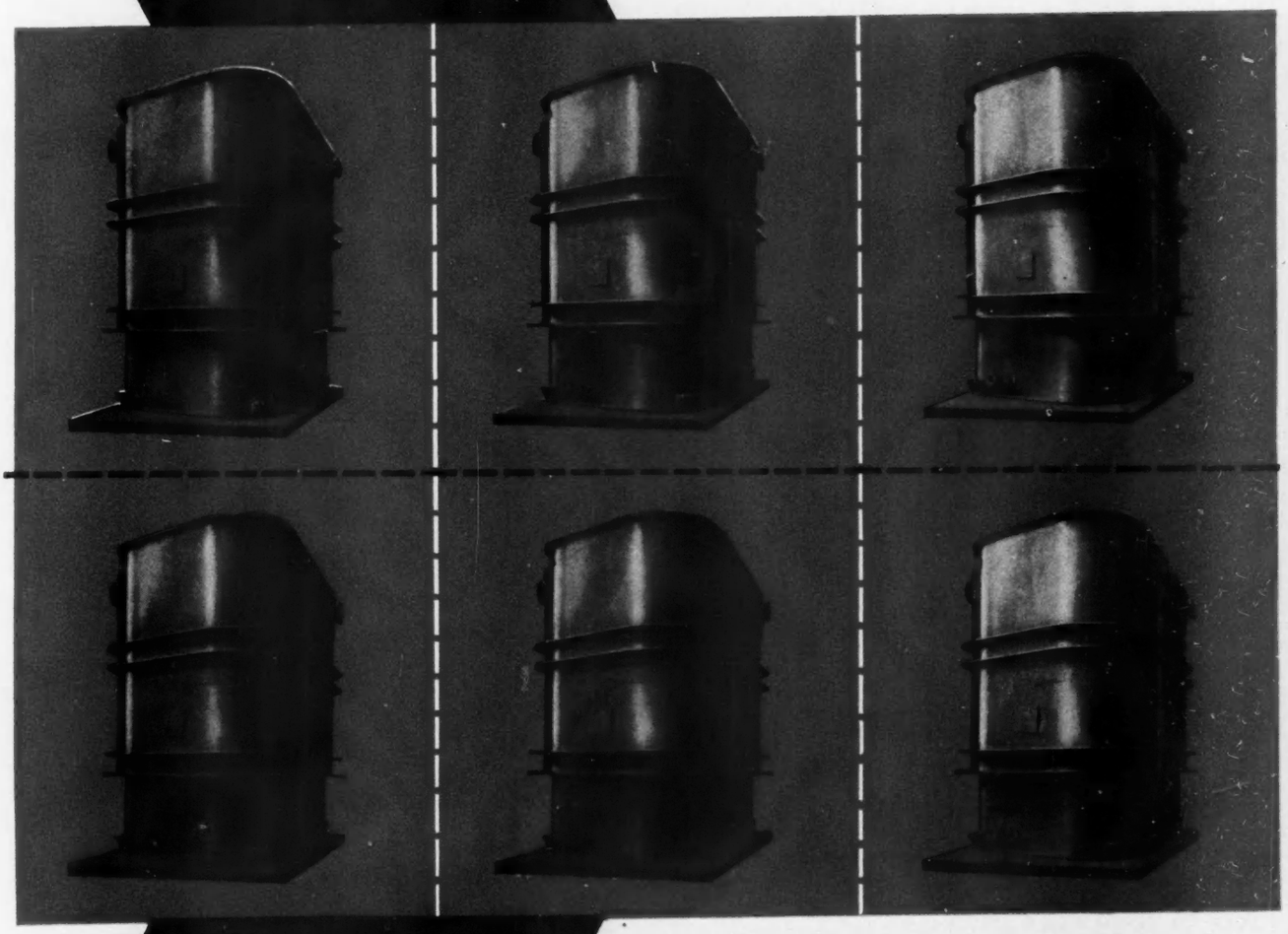
*we also supply*
**Four-stroke engines with or without pressure induction as oil or dual-fuel engines up to 2,100 b.h.p.**

# HARLAND & WOLFF
LIMITED

Enquiries: Queen's Island, Belfast
London Office: 9, Whitehall, S.W.1

BELFAST GLASGOW LONDON LIVERPOOL SOUTHAMPTON

# 85 TONS OF Service



To fabricate from ¾" mild steel plate six tanks each weighing over 14 tons and standing thirteen feet high is in itself something of an achievement. But these tanks were for testing high-voltage switchgear by oil immersion and therefore had to be oil-tight in addition to combining maximum strength with minimum weight.

This emphasises another aspect of Weldall & Assembly service. Not only are welded fabrications of any size well within our skill and workshop capacity, but we commonly carry out the necessary tests to ensure that each structure is fit for duty. Which, since we frequently design the structures to meet our clients requirements, amounts to a complete service, to say the least of it.

**WELDALL**

Member of the TRIPLEX Safety Glass Group of Companies

**WELDALL & ASSEMBLY LIMITED,**
**STOURBRIDGE · WORCESTERSHIRE**

**LONDON OFFICE:**
10, Norfolk St., Strand, W.C.2. Tel: COVent Garden 0315

**MANCHESTER OFFICE:**
466, Royal Exchange, Manchester, 2. Telephone: Deansgate 5131

No. 3

THIS CAST STEEL
SERVOMOTOR CYLINDER

bolted to the flange of a 121.660 pound Kaplan turbine shaft for Jochenstein (Austria) Hydro-electric Power Station is just another example of RUHRSTAHL'S excellent workmanship backed by a hundred years of experience and technical development in the manufacture of the heaviest high-quality Forgings and Steel Castings for Hydroelectric Plant Supply in alloyed and unalloyed steel.

RUHRSTAHL

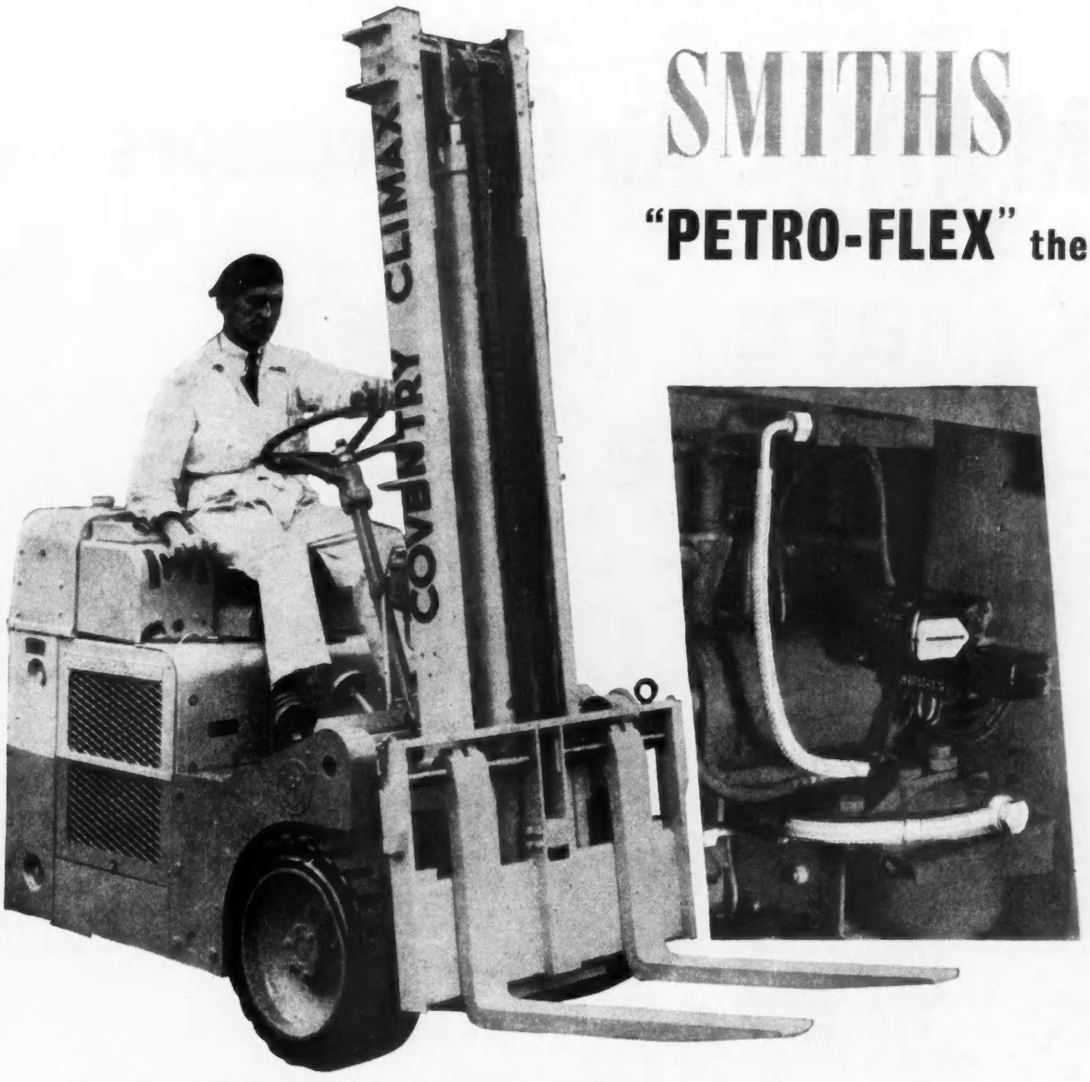
DATA: Dia. of servomotor cylinder: 6' 9"
Dia. of bearing collar : 7'
Overall length : 37'
The turbine shaft also supplied by us was forged out of a 170 ton ingot.

RUHRSTAHL AKTIENGESELLSCHAFT
HENRICHSHÜTTE·HATTINGEN·RUHR·(WESTERN GERMANY)

*Agents for Scotland, Newcastle-on-Tyne and Northern Ireland:* **A. & J. McCulloch & Miller, 180, West Regent Street, Glasgow, C.2.**
*Agents for England:* **Dr. W. F. Riester, 9, Great Pulteney Street, Piccadilly, London, W.1.**

# SMITHS

## "PETRO-FLEX" the versatile tubing

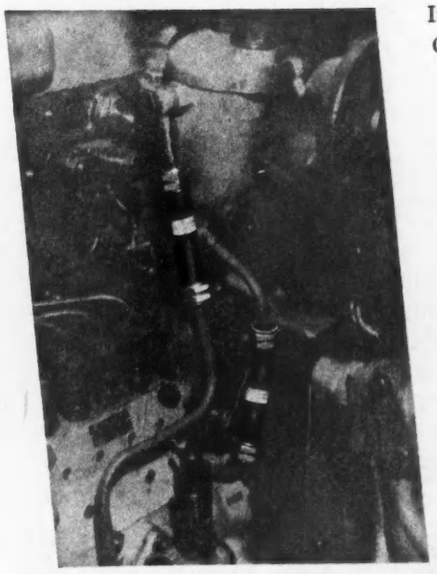





"Petro-flex" is a strong, light-weight flexible tube consisting of an extrusion of synthetic rubber which is unaffected by the action of water, petrol, gases, vegetable or mineral oils and a variety of industrial solvents within a range of —40°C to +80°C.

'Petro-flex' withstands working pressures of up to 250 p.s.i. and will give trouble-free service for as long as the engine will run. Available in diameters from $\frac{3}{16}$" to 3".

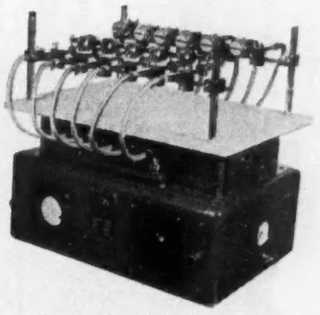
### Coventry-Climax Ltd. use "PETRO-FLEX"



In these instances (above and left), "Petro-flex" is being used in the fuel lines of Coventry Climax diesel engined Fork Lift Trucks to absorb vibration.

### Standard Telephones & Cables Ltd. use "PETRO-FLEX"

This Type G.100 'Stanelco' Electro-gas Heating equipment, the first of its type to be built in this country, uses "Petro-flex" to convey gas and air to its burner connections. A further set of these tubes is fitted inside the cabinet. By its ability to take up acute angles, "Petro-flex" tubing enables the equipment to maintain compact overall dimensions.



*Write now for Leaflet CY 615 and at the same time pose our Technical Department with your particular tubing problem.*

"Petro-Flex" is the registered Trade Mark of the Petro-Flex Tubing Co. Ltd.

SMITHS INDUSTRIAL INSTRUMENTS LTD

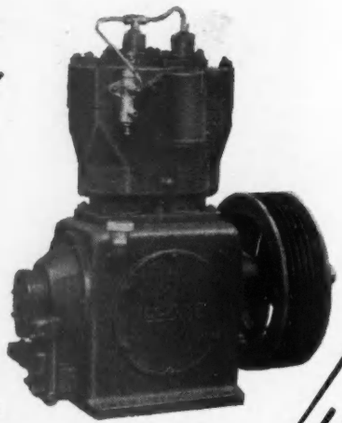
SMITHS

CHRONOS WORKS, North Circular Road, London, N.W.2.
BELFAST OFFICE: 19 *Ormeau Avenue, Belfast, N. Ireland.*
BRISTOL OFFICE: 42 *Wellford Road, Stapleton, Bristol.*
GLASGOW OFFICE: 123/145 *North Street, Glasgow, C.3 Scotland.*
MANCHESTER OFFICE: *York House, 12 York Street, Manchester.*
*The Industrial Instrument Division of S. Smith & Sons (England) Ltd.*

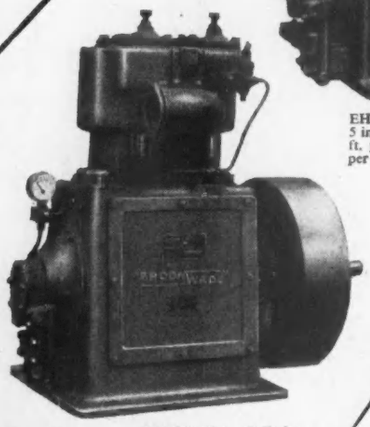
AP. 188-306

# "BROOMWADE" Air Compressors are reliable

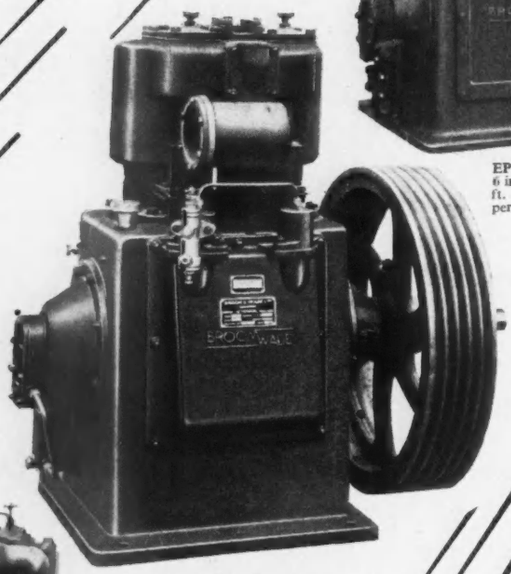
- ★ Simple design
- ★ Slow speeds
- ★ Adequate cooling
- ★ High performance
- ★ Low initial cost
- ★ Low maintenance cost
- ★ Proved long life



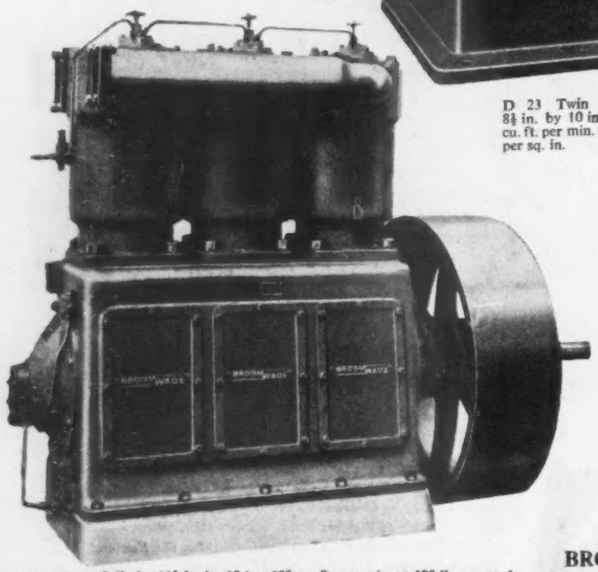
EH 220 Twin Cylinder 5 in. by 6 in., 50-60 cu. ft. per min. at 100 lb per sq. in.



EP 660 Twin Cylinder 6 in. by 6½ in., 100 cu. ft. per min. at 100 lb. per sq. in.



D 23 Twin Cylinder 8¾ in. by 10 in. 200-220 cu. ft. per min. at 100 lb. per sq. in.



EH 255 Three Cylinder 11½ in. by 12 in., 600 cu. ft. per min. at 100 lb. per sq. in.

## RELIABILITY

— that is the foundation upon which "BROOMWADE" has built up an enviable, world-wide reputation. But "BROOMWADE" does not rest on its laurels. By constant research and development, efficiencies are improved and machines kept abreast of any competitive design. You can rest assured that "BROOMWADE" will give you EFFICIENT and TROUBLE-FREE service — that is the opinion of an ever increasing number of users.

***WRITE NOW FOR FULL DETAILS***

## "BROOMWADE"

***Air Compressors and Pneumatic Tools***

**YOUR BEST INVESTMENT**

**BROOM & WADE LTD., P.O. BOX No. 7, HIGH WYCOMBE, ENGLAND**

*Telephone: High Wycombe 1630 (10 lines).* *Telegrams: "Broom," High Wycombe, Telex.*

501 SAS

A NATIONAL COAL BOARD PRODUCT

# FILTER COAL

Produced from selected High-quality

## WELSH ANTHRACITE

**AN EXCELLENT FILTRATION MEDIUM FOR GRAVITY AND PRESSURE FILTERS, FOR THE TREATMENT OF HARD AND SOFT WATER, SEWAGE, OIL AND ACID/ALKALI LIQUIDS**

*The advantages of FILTER COAL compared with other filtration media are*

- LESS BUILD-UP OF MUDBALLS AND COATINGS
- LESS REACTIVE CONSTITUENTS
- INCREASED FILTRATION RATES
- SAVING OF WASH WATER
- LONGER FILTER RUNS
- LOWER LOSS OF HEAD

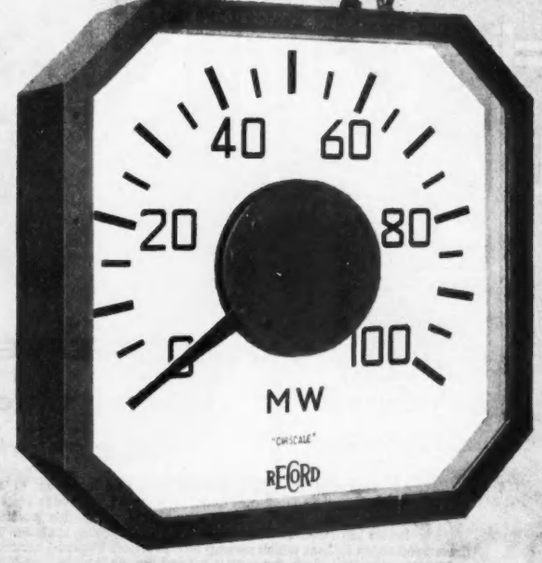
★ Size range to suit all filter designs. Prompt deliveries from the new preparation plant at Port Talbot. ★

*Enquiries for Export and Inland Supplies are invited and should be addressed to*

**THE NATIONAL COAL BOARD**
*Marketing Department*
GLOUCESTER HOUSE, GLOUCESTER PLACE,
SWANSEA - GLAM.
*Tel:* SWANSEA 51541 *Grams:* MARKETING, SWANSEA

---

**Mammoth**




**"Cirscale"**

With a scale length of 5 feet, bold figures and internal illumination, this instrument can be read accurately at considerable distances. It complies fully with BSS 89/1954 and combines ample power with high sensitivity. It is suitable for indicating Amps, Milliamps, Volts, R.P.M. or Frequency, or any value which may be converted into one of these. Single or double sided models available

by RECORD

THE RECORD ELECTRICAL CO. LTD · 'CIRSCALE' WORKS · BROADHEATH · ALTRINCHAM · CHESHIRE

*designed for your particular need*

**SPRAYCONE & FANJET Nozzles**

Engineered projects to-day demand plant to exact specifications. This applies equally to Spray Nozzles. Our large range ensures a standard nozzle to meet your need.
Call on our experience to aid your choice.

WRITE FOR CATALOGUE

**H·T·Watson Ltd.**
CROFT ST · WIDNES · ENGLAND
*Phone* WIDNES 2313 *Grams* WATSON WIDNES

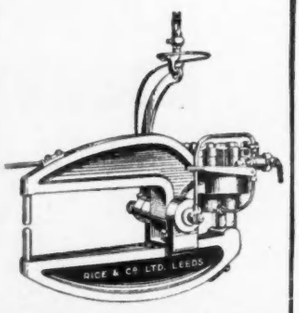
# RICE-HYDRAULIC Machine Tools

RICE & Co. (Leeds) Ltd., ELLAND ROAD, LEEDS 11

Telephone: LEEDS 75305

MAKERS OF

Pumps, Accumulators, Riveters, Presses for Flanging, Bending and Straightening, Deep Pressing, Lead Pipe Extrusion, Baling Steel Scrap, Wool, Cotton, etc.




HYDRAULIC HINGED RIVETER
1'-6" to 3'-0" Gap. 20 to 30 tons power.

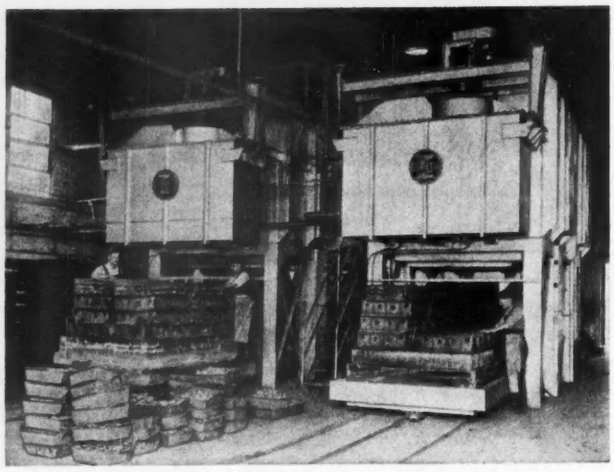
*London Office:* 49, Queen Victoria St. E.C. Telephone CITy 7546

# MALLEABLE IRON CASTINGS

## ANNEALED IN THE MOST MODERN GASEOUS DECARBURISING PLANT

*Excellent Physical Properties*

*From:*
**PLATT MALLEABLE CASTINGS LTD.**
CLIVE FOUNDRY · LEAMORE · WALSALL



# Wire (Stainless)

As Manufacturers of Austenitic Stainless Steel Wire, we can cover all your requirements to DTD, BS, AISI, etc., specifications.

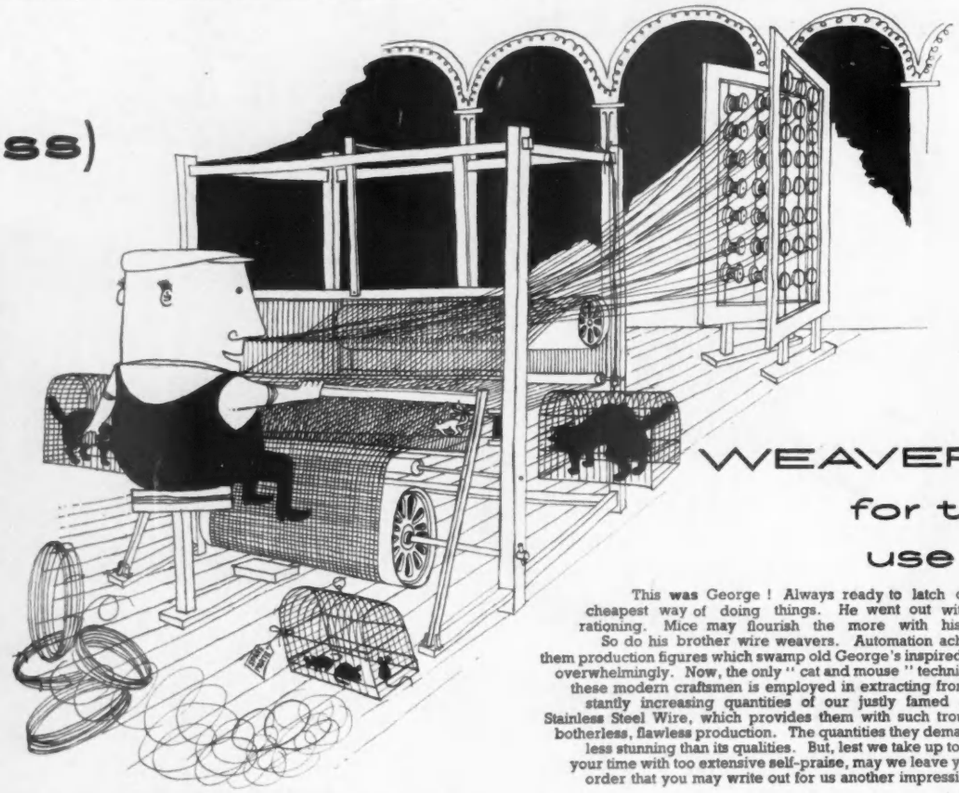
These specifications include DTD 189, DTD 489, DTD 549, DTD 571, DTD 734, DTD 2002, etc.

•

BS 2056, BS 1554, BS 1453, W10, W11, E20, etc.

•

AISI 302, AISI 304, AISI 316, AISI 321, AISI 347, etc. or to your own specifications. AID and ARB approved.



## WEAVERS for the use of

This was George! Always ready to latch on to the cheapest way of doing things. He went out with cheese rationing. Mice may flourish the more with his passing. So do his brother wire weavers. Automation achieves for them production figures which swamp old George's inspired concepts overwhelmingly. Now, the only "cat and mouse" technique left to these modern craftsmen is employed in extracting from us constantly increasing quantities of our justly famed Austenitic Stainless Steel Wire, which provides them with such trouble-free, botherless, flawless production. The quantities they demand are no less stunning than its qualities. But, lest we take up too much of your time with too extensive self-praise, may we leave you now in order that you may write out for us another impressive order.

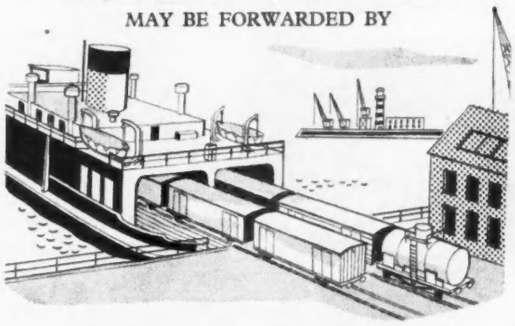
**STAINLESS STEEL WIRE CO. LIMITED**

THE BARRACKS · LANGSETT ROAD · SHEFFIELD, 6

*Telephone:* SHEFFIELD 44241 *Telegrams:* FINEWYRE SHEFFIELD

# Merchandise

MAY BE FORWARDED BY



# Through Wagons

TO DESTINATION BETWEEN

**GREAT BRITAIN & THE CONTINENT**

* *London - Harwich - Zeebrugge (Daily in each direction)*

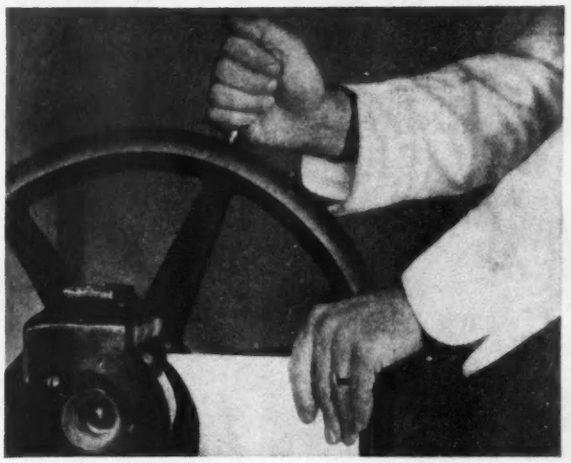
* *London - Dover - Dunkerque (Two to Four sailings daily in each direction)*

*Packing and handling absolute minimum*

Full particulars from:— Continental Superintendent, Victoria Station, London, S.W.1 for Dover route and Continental Traffic & Shipping Manager, Harwich House, 129 Bishopsgate, London E.C.2 for Harwich route

BRITISH RAILWAYS

# Are these hands helping you?



Chemists on our staff make sure that the P.J. finishing paints you use are ahead of competition, Pinchin Johnson maintain a separate laboratory where customers' requirements are studied and formulations evolved to meet them. Your P.J. Representative, himself a trained technician, is the link that makes the country's most advanced paint research centre an effective annexe to your factory.

*You can rely on*

## PINCHIN JOHNSON

*for Paint and Service*

PINCHIN, JOHNSON & CO., 4 CARLTON GARDENS, S.W.1

*Telephone: TRAfalgar 5600*

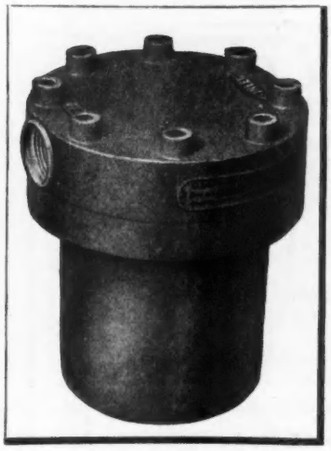
BELFAST · BIRMINGHAM · BOOTLE · BRIGHTON · BRISTOL · GLASGOW
LEEDS · MANCHESTER · NEWCASTLE-ON-TYNE · SOUTHAMPTON

★

**POROUS METAL PACK TYPE**

*high pressure*

# FILTERS



For use in high pressure hydraulic systems, in test rigs and similar applications, we manufacture a comprehensive range of first-class Filters.

The standard range comprises sizes from fractional to 2" bores, with capacities from 60 to 2,000 galls. per hour, and working pressures up to 6,000-lbs. per sq. inch. Other sizes made to order.

*We seek your enquiries, and offer new Catalogue in post.*

G. & A. FIRKINS LTD.

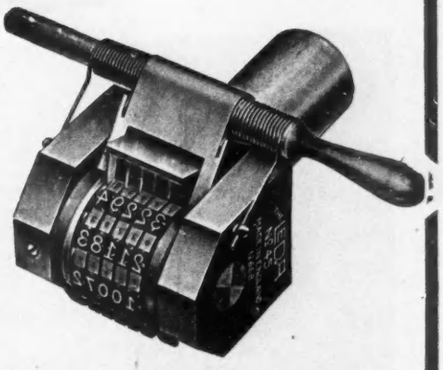
FIRTOP WORKS, STOKE HEATH, BROMSGROVE, WORCS. Tel: BROMSGROVE 3246/7/8

FIRTOP

# NUMBERING on METAL

"LEDA" NUMBERING MACHINES

***NUMBERING HEAD for METAL***



*Consecutive and Repeat actions*

**Power, Fly, Hand or Pneumatic Presses and similar equipment**

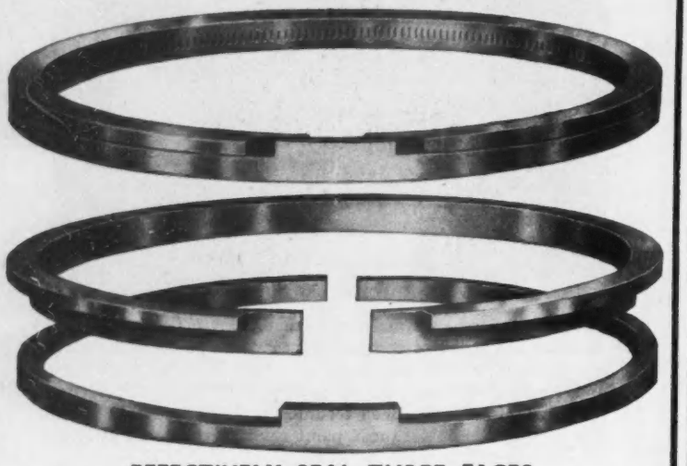
It is used for marking Aircraft components with reference numbers, part and drawing numbers, date of manufacture, inspection mark for marking Shells, Bombs, Cartridges, Engine Parts, Motor Car, Motor Cycle, Cycle, Wireless, Electrical, Clock, Watch and other instrument parts in all materials. Checks, Labels, Name Plates, Pidgeon Rings, in fact, any article which requires an identification mark. Massed produced articles can only be satisfactorily identified by individual reference number.

## W. LETHABY & Co LTD

LEDA HOUSE, 124-132 CLERKENWELL ROAD, LONDON, E.C.1

*Telephone: Terminus 1104 (3 lines)*

# STANDARD'S TRIPLE SEAL PISTON RINGS



**EFFECTIVELY SEAL THREE FACES**

Eliminate by-pass, Restore compression, Maintain full power, Function until bore of cylinder is worn by as much as 1%.

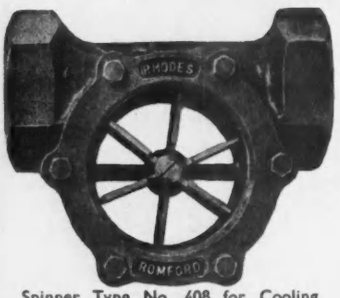
**THE STANDARD PISTON RING & ENGINEERING CO., LTD.**

PHONE: Sheffield 42076-7-8 (three lines). **DON ROAD, SHEFFIELD,** GRAMS: OCEAN SHEFFIELD.

London Office: Walter C. Jones, M.I.Mech.E., M.I.Mar.E., 57-58, Gresham House, Bishopsgate, E.C.2 (London Wall 4981)

# RHODES SIGHT FLOW INDICATORS

**For Chemicals, Oils and cooling water**




Spinner Type No. 408 for Cooling Water or oil circuits, vertical, upward or downward and horizontal flow.

are made in
BRONZE CAST IRON
MONEL INCONEL
PURE NICKEL
STAINLESS STEEL
ANTIMONIAL LEAD
NICKEL MOLYBDENUM

ALL TYPES AVAILABLE WITH SCREWED OR FLANGED ENDS

*May we have your enquiries:—*

**B. RHODES & SON LTD.**
QUEEN STREET, ROMFORD, ESSEX
Telephone: ROMFORD 62333 & 62334

# CASTINGS

**HIGH QUALITY ENGINEERING & MACHINE TOOL CASTINGS**

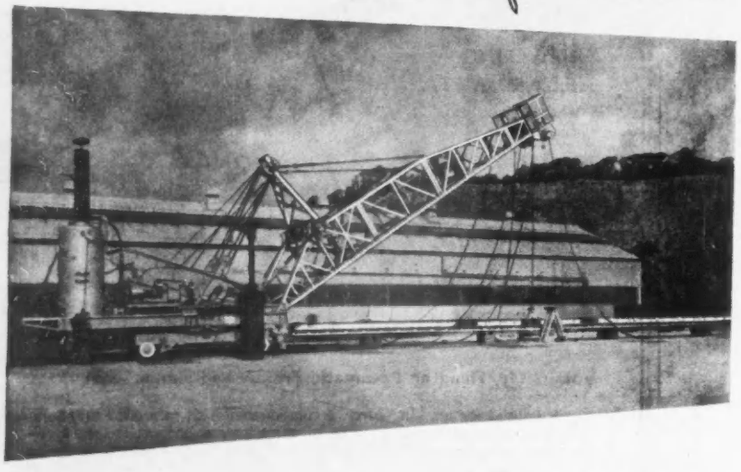
*HEAT & WEAR RESISTING UP TO 10 TONS also in SPHEROIDAL GRAPHITE IRON & STEEL*

**MACHINING**

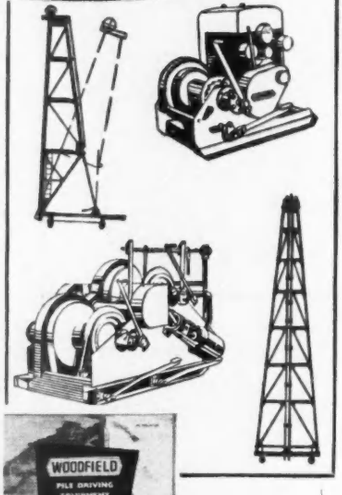
**R. GOODWIN & SONS (ENGINEERS) LTD.**
IVY HOUSE FOUNDRY, HANLEY, STOKE-ON-TRENT Phone: Stoke-on-Trent 23612

# WOODFIELD Complete PILING PLANT

*For Sale or Hire*

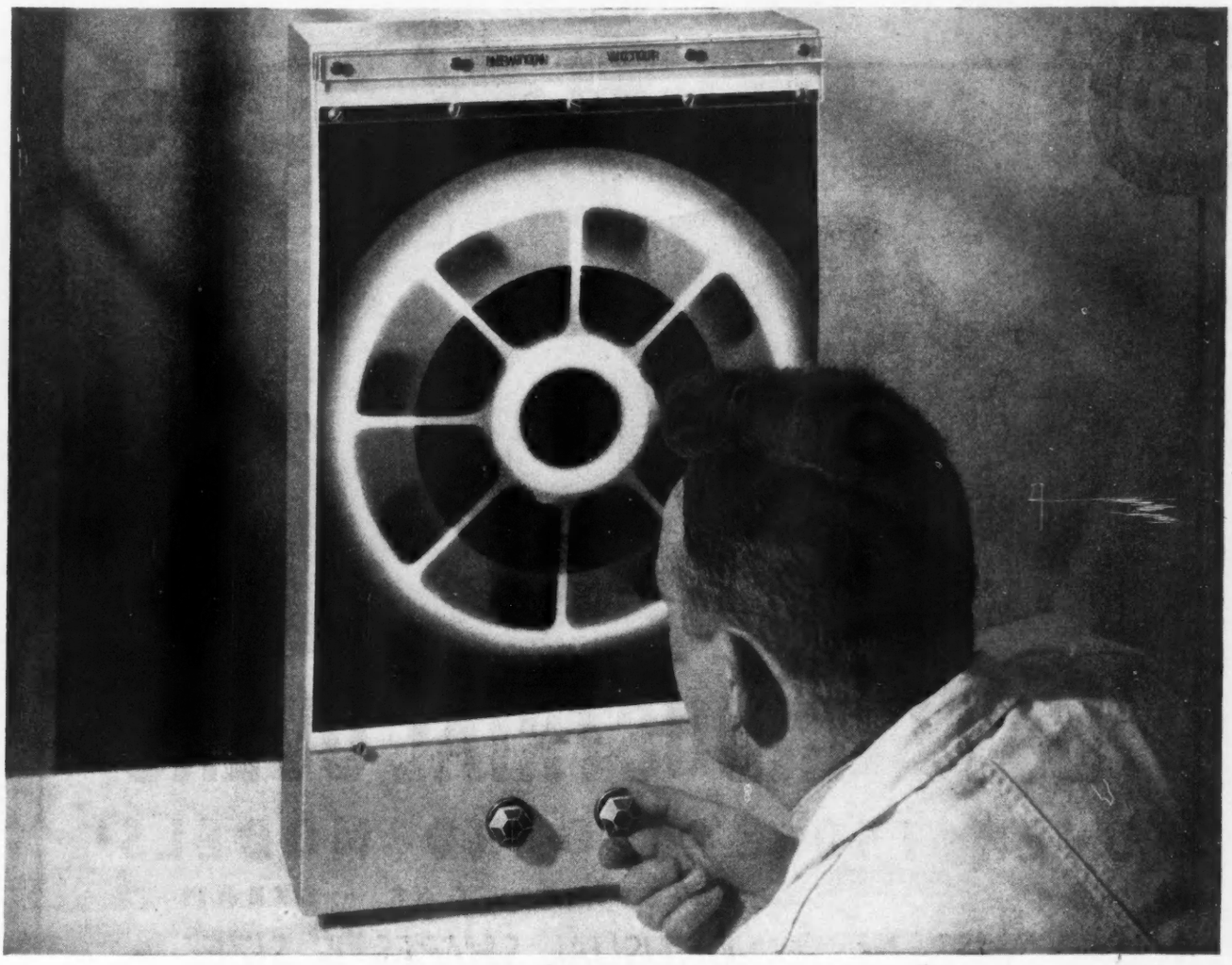


Completely self-erecting Woodfield 7/100 Universal Pile Driving Plant with 100 ft. leader.



Write for latest publication "Complete Piling Plant."

**WOODFIELD HOIST & ASSOCIATED INDUSTRIES LTD.**
Makers under Licence of (IBECO) Oilfield Equipment
Frindsbury Works · Rochester · England
Telephone: STROOD 78421 (5 lines) Telegrams: WOODFIELD-TELEX-ROCHESTER Telex: 89100 WOODFIELDSTROOD
London Office: 147, Victoria Street, S.W.1
Telephone: TATe Gallery 4135 Telegraphic Address: Powerigs London
associating:
KENWORTHY JIG & PRESS TOOL COMPANY LTD. HIGH STREET, COLLIERS WOOD, LONDON, S.W.19.
R. H. CORBETT AND COMPANY LIMITED HYDRUM WORKS, BURGESS HILL, SUSSEX



# THE NEW MAXILUME ILLUMINATOR

## incorporates all those improvements that ensure greater accuracy and convenience for critical examination of X-ray negatives.

**VERSATILE**—Radiographs up to 14″ x 17″. Desk, bench, wall or recessed wall mounting. With or without dimming circuit.

**CONVENIENT**—It tilts at just the right angle for comfortable viewing. Can be placed with viewing panels touching to form continuous bank.

**EFFICIENT**—Instant start. Complete absence of flicker. Correct maximum light transmission characteristics for critical examination of radiographs without eyestrain.

**COMPACT**—Only 4½ in. deep. Facilitates recessed wall mounting. No surround. Saves space.

**UNIQUE**—Ball-type film holder ensures quick trouble-free insertion, retention & release of negatives. Attractive durable cream finish.

**ACCESSORIES**

*Roller Blind Masking Set eliminating extraneous illumination permits closer examination of small radiographs or parts of negatives.*

*One piece Perspex drip tray set for viewing wet negatives.*

*Photoflood for examination of dense negatives up to 2.5.*

*Dimming circuit and regulation of light intensity for critical viewing of fine negative detail.*

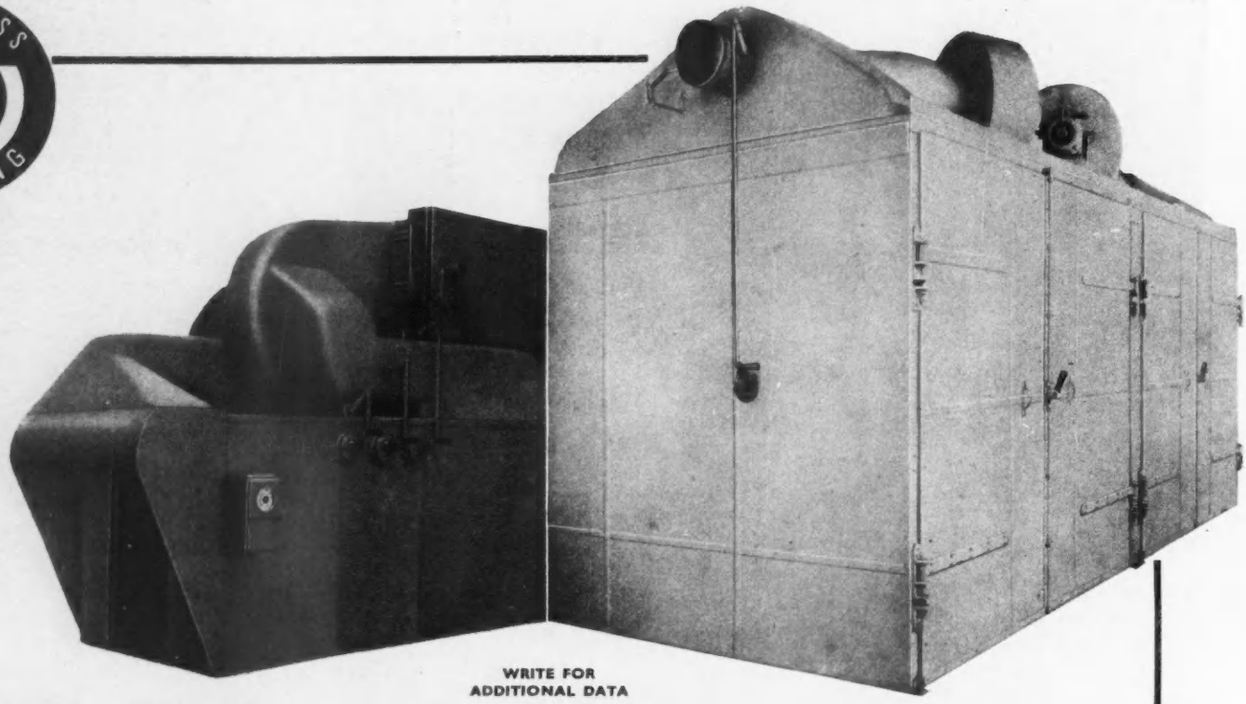
With dimmer **£15.15.0d.** Without **£13. 0. 0d.**

**Newton Victor Limited, 132 LONG ACRE, LONDON, W.C.2**

X-RAY SALES DEPARTMENT OF METROPOLITAN-VICKERS ELECTRICAL CO LTD · TRAFFORD PARK · MANCHESTER, 17

*An A.E.I. Company*

V/X 801.



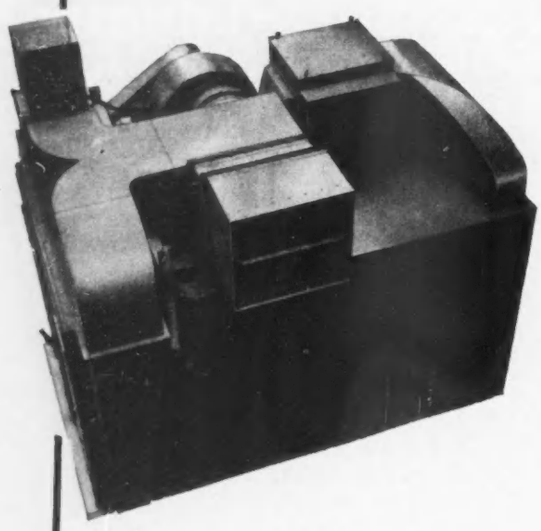
WRITE FOR
ADDITIONAL DATA

# 'B-W' INDUSTRIAL OVENS

## OVER 150 STANDARD MODELS

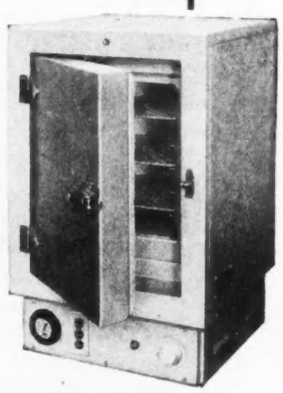
**ELECTRIC · GAS · STEAM**

*UNUSUAL SHAPES & SIZES TO SPECIAL ORDER*



Barlow-Whitney are acknowledged specialists in the production of Industrial Heating Equipment. Their standard range includes:

**VACUUM IMPREGNATING PLANT · FURNACES · OIL AND GAS HEATERS TROPICAL CHAMBERS HUMIDITY CABINETS SALT AND SOLDER BATHS AND HOTPLATES**



WRITE FOR OUR EQUIPMENT BROCHURE No. 5B

Barlow-Whitney LTD

BARLOW-WHITNEY LTD., 2, DORSET SQUARE, LONDON, N.W.1. TEL: AMBASSADOR 5485. WORKS: LONDON & BLETCHLEY

BMJ

# TWO BERTHIEZ VERTICAL BORERS*

(MODELS 9340)

The Berthiez Vertical Borer is a single upright machine with side head suitable for high-speed turning, boring, screwcutting, drilling, milling and slotting. Because the model 9340 has a displaceable table and a wide range of table speeds (2·5 to 125 r.p.m.), both small and large components can be machined ; the Berthiez is in effect two borers in one.

The table bearing is specially designed to support a maximum load almost equivalent to the weight of the machine itself. Weights up to 20 tons can be safely machined without distortion.

Standard equipment includes : Swivel side toolhead mounted on upright with four position square revolving toolholders. Screwcutting attachments for SI and Whitworth threads. Taper turning attachment. Four loose steel chuck jaws.

Additional equipment comprises : One set of gears for reducing feed rates. Special auxiliary gear box giving a reduction of 4 to 1.

**Immediate delivery**
**Special price ex site**

## MODEL 9340

### MACHINE DETAILS

| | |
|---|---|
| Diameter of Table | 8′ 0″ |
| Max. Diameter Possible for Machining | 9′ 6″ |
| Max. Diameter Possible for Machining to centre | 8′ 6″ |
| Max. height admissible under arm | 6′ 3″ |
| Table speeds | 18 |
| Range of speeds :— | 2·5 ; 3·15 ; 4 ; 5 ; 6·3 ; 8 ; 0·6 ; 0·8 ; 1 ; 1·25 ; 10 ; 12·5 ; 16 ; 20 ; 25 ; 31·5 ; 1·6 ; 2 ; 40 ; 50 ; 63 ; 80 ; 100 ; 125 : R.P.M. |
| Toolholder feeds | 16 |
| Range of feeds :— | ·008 ; ·01 ; ·017 ; ·025 ; ·031 ; ·021 ; ·034 ; ·041 ; ·050 ; ·062 ; ·067 ; ·083 ; ·100 ; ·125 ; ·250/REV. |

* *In 'as new' condition*

Newman

**NEWMAN INDUSTRIES LIMITED**

*Machine Tool Division* YATE · BRISTOL

*Telephone :* **CHIPPING SODBURY 3311** *Telegrams :* **"DYNAMO YATE"**

*Branches at: London (Sloane 8206) Birmingham (Midland 1143) Manchester (Deansgate 2837/8) Glasgow (Central 2101/2)*

Q

WHERE QUALITY IS IMPORTANT...

LANGLEY

*Corrosion Resistant*

NICKEL ALLOYS

**are unsurpassed**

Please ask for full details of the Langley range of Nickel Alloys for duties where reliability in service is essential

LANGLEY ALLOYS LIMITED · LANGLEY · SLOUGH · BUCKS

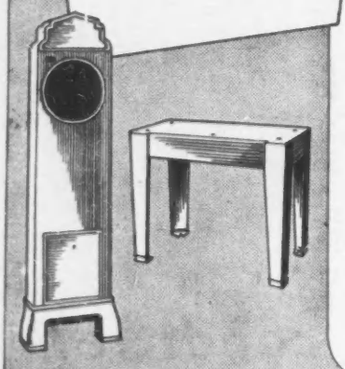
*TELEPHONE: LANgley 432 (7 lines)*

LANGLEY Special ALLOYS

***Sheet Metal Workers of Repute***

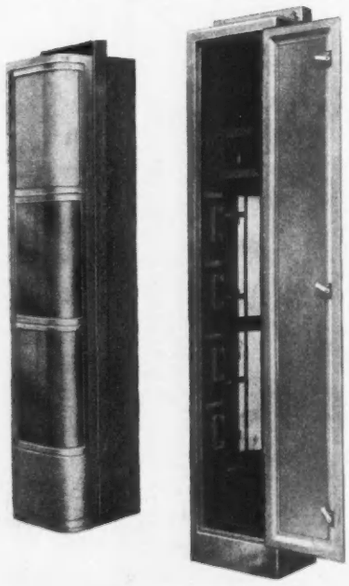
***Established 1857***

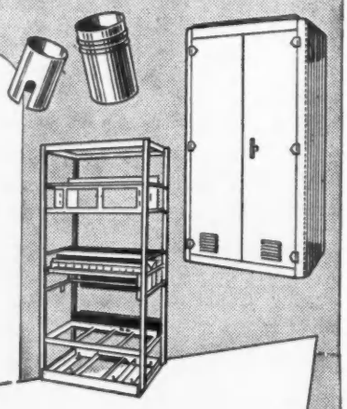
**We have modern plant and 100 years Experience which enables us to carry out a great variety of work and meet all needs.**



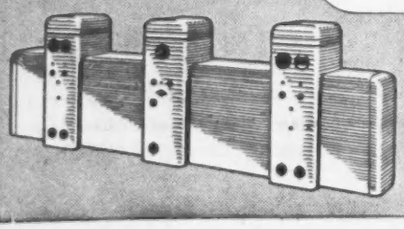
Part of the electronic computer equipment for a totalizer is housed in the seven foot high cabinet illustrated. The angle and channel frame work is of robust construction with 16 gauge panels and curved perspex windows.

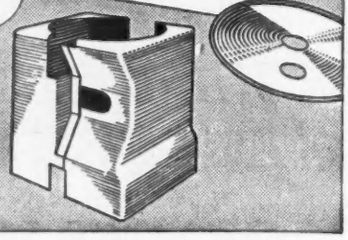
Contractors to Admiralty, Ministry of Supply and G.P.O.





**Well-equipped tool-room for the manufacture of the necessary tools to your designs or our own.**





**J. RICHARDS & SONS LTD.**

31 - 37 WELLESLEY ROAD · CROYDON · SURREY

*Telephone: CROYDON 2128/9*

famous for forgings of

all descriptions
in alloy and Carbon Steels
(all heat treatment facilities)

T. S. FORSTER & SONS LTD
FORGEMASTERS AND ENGINEERS
COPPERAS BANK FORGE, SUNDERLAND
TEL: 2876 'GRAMS 'FRAMES' S'LAND

ODDIE FASTENERS

PAT. NO. 507249

THE GENERAL PURPOSE FASTENER FOR ENGINEERS.

Simple—Positive—Self Locking. Made in a variety of types and sizes. Special Fasteners to suit customers' requirements.

Used on aircraft, automobiles, coaches, caravans, rail coaches, electrical, radio and radar units, refrigerators, marine craft, display equipment, etc.

For quickly detachable doors, covers, panels, access covers, etc.

For full details and literature apply to

ODDIE BRADBURY & CULL LTD — PORTSWOOD RD. — SOUTHAMPTON
TEL: 55883 CABLES: FASTENERS, SOUTHAMPTON

MANUFACTURING AND DESIGN OF MACHINERY FOR:—
TEXTILE—INCLUDING PLASTIC COATING PROCESS,
GAS & COAL BOARDS,
FROZEN FOOD INDUSTRIES

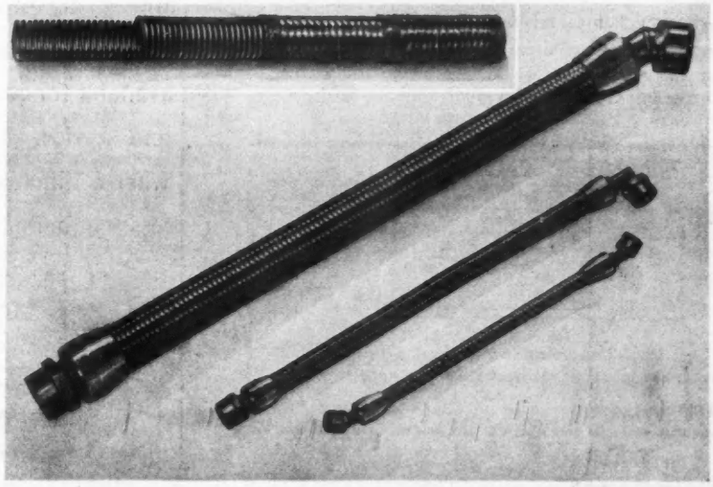
EDGAR C. BURRELL & SONS LTD. ENGINEERS EST. 1884

ADDRESS—
SOUTHTOWN,
GT. YARMOUTH
PHONE 2009

SUB-CONTRACTING
— UNDERTAKEN —
MACHINING & ASSEMBLY
TURNING TO 20' LG. x 3' 6" DIA.
FABRICATIONS TO FIVE TONS

FLEXIBILITY

In the countless applications involving transmission of fluid under pressure and temperature there is a component to suit every type of installation. A complete range of flexible metallic tubing and bellows in many metals and alloys, with unions, is at your service.



BOA Stainless Steel Super-Metalflex Tubing all-metal corrugated type combining light weight and optimum flexibility with non-corrosive properties.

This versatile product is used extensively in modern aircraft for fuel, lubrication, ignition harness, and all services, where reliability is of first consideration.

THE POWER FLEXIBLE TUBING COMPANY LTD.

DERBY WORKS · VALE ROAD · LONDON, N.4
Tele: STAMFORD HILL 6696. Grams: METALFLEX, EASPHONE, LONDON.

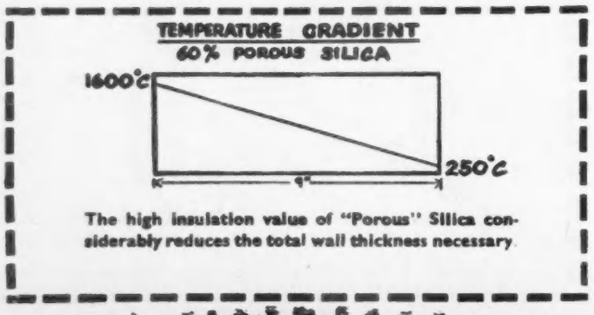
*Makers of Reliable Flexible Metallic Components for over half a century*

# CONSETT POROUS SILICA

## A really high-temperature INSULATION...

- Developed and manufactured by the Consett Iron Company Limited, "Porous" Silica Insulating Bricks have become established as an important addition to the existing range of refractories.
- Possessing the advantages of a normal silica brick combined with high thermal efficiency, "Porous" Silica offers to the furnace builder a spalling resistant silica refractory suitable for hot-face insulation at high temperatures.
- Already in wide use in the glass industry for roof insulation, "Porous" Silica Brick is also suitable for the construction of kiln roofs and side walls where its light weight and insulating properties are important factors in design and service.
- "Porous" Silica Bricks are made in two grades, 60% and 50% porosity, the latter possessing a higher mechanical strength, rendering it the most suitable for constructional work.

*Further information will be gladly supplied on request.*




The high insulation value of "Porous" Silica considerably reduces the total wall thickness necessary.

**CONSETT IRON CO.**
LIMITED
CONSETT · CO. DURHAM · ENGLAND

Telephone: Consett 341 (12 lines) Telegrams: STEEL PHONE, Consett.

## but we tailor in stainless steel

Made to measure jobs are our speciality. Vats, vessels and machine parts in heat-resisting and corrosion-resisting materials—particularly stainless steel and nickel alloys are usually problems, but they're problems we take on every day of the year. Our technical department is always available for consultation, advice and service. Call us in and see what a difference superb stainless steel tailoring makes.

for instance . . .

*Laboratory paint kettle in heat-resisting stainless steel.*

**WELDING TECHNICAL SERVICES LTD.,**
*ENGINEERS AND FABRICATORS*
HURST MILL, KINGS NORTON, BIRMINGHAM 30

PHONE: KINGS NORTON 2360/2555. GRAMS: WELTEXA, BIRMINGHAM

# CLASSIFIED ADVERTISEMENTS

**AGENCIES • DIRECTORS • PARTNERSHIPS • SITUATIONS VACANT • EDUCATIONAL PATENTS BUSINESS OPPORTUNITIES • MISCELLANEOUS • PUBLIC APPOINTMENTS BUSINESSES and PREMISES • TENDERS**

**Lineage Rate.** 4/- per line of approximately 6 words. Minimum 16/-.

**Inch Rate.** 48/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, *e.g.*, ¼-page £25 10s. ½-page £48. Full page £90.

**AUCTION SALES • FOR HIRE • MACHINERY, etc., WANTED • SITUATIONS WANTED DRAWING AND DESIGN SERVICES • FOR SALE • SUB-CONTRACTING**

**Lineage Rate.** 3/6 per line of approximately 6 words. Minimum 14/-.

**Inch Rate.** 42/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, *e.g.*, ¼-page £22. ½-page £41 10s. Full page £78.

**Series Discounts.** For advertisements 1 inch and upwards. 6 insertions 5%. 13 insertions 10%. 26 insertions 15%.

**Run-On and Semi-Displayed Styles.** Both these styles are available for single column width advertisements of any depth up to 12 inches.

**Displayed and Illustrated Styles.** The minimum size for a Displayed advertisement is 3 inches single column, for an illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.

**Use of Box Number.** 2/-, which includes forwarding of replies.

**Copy Dates.** "Run-on" and "Semi-Displayed" advertisements by noon Tuesday for publication on Friday same week. "Displayed" and "Illustrated" advertisements by noon Friday for publication on following Friday. All advertisements three days earlier if proofs are required.

***Advertisements for publication should be addressed to:*— Classified Advertisement Dept., "The Engineer", 28 Essex Street, Strand, London, W.C.2.**

*Urgent advertisements may be telephoned to* CENtral 6565.

## PUBLIC APPOINTMENTS

### COUNTY BOROUGH OF DONCASTER EDUCATION COMMITTEE

#### DONCASTER TECHNICAL COLLEGE

Principal:
W. LOMAX, M.Eng., B.Sc., A.M.I.Min.E.

#### LECTURERS

Applications are invited for the posts of TWO LECTURERS in the Mechanical Engineering Department of the above College to teach subjects up to Higher National Certificate Level, one of whom should be able to teach Metallurgy.

Applicants should possess a University Degree, or equivalent, with suitable industrial and teaching experience. Associate Membership of the appropriate professional institution would be an advantage.

Salaries for these posts will be in accordance with Burnham (Technical) Scales. Commencing salary will be dependent upon teaching and industrial experience.

Application forms may be obtained from the undersigned and should be completed and returned as soon as possible.

V. H. HOSKIN,
Chief Education Officer.

Education Offices,
Whitaker Street,
Doncaster. E6002

### EAST HAM COUNTY BOROUGH

#### GRAMMAR SCHOOL FOR BOYS

#### HEAD OF DEPARTMENT

A new Department of Engineering will be established next September in this large Grammar School of 900 boys, and a fully equipped workshop is in course of construction.

Applications are invited for the post of HEAD of this DEPARTMENT (Grade "B," allowance £200) from well-qualified candidates, preferably with industrial experience.

The successful candidate will be expected to develop the course to an advanced level and to teach engineering metalwork and workshop practice to grammar school pupils and to pupils, aged 14–16 years, from two neighbouring secondary schools with engineering courses.

Burnham Scale (London area).

Application forms (returnable as soon as possible) and further particulars from Chief Education Officer, Town Hall Annexe, Barking Road, London, E.6. E6018

### THE UNIVERSITY OF LIVERPOOL

#### DEPARTMENT OF MECHANICAL ENGINEERING

#### LECTURER

Applications are invited for the post of ASSISTANT LECTURER or LECTURER in the Department of Mechanical Engineering. The salary range for an Assistant Lecturer is £700–£850 per annum; the initial salary for a Lecturer will be within the range £900–£1650 per annum, according to qualifications and experience.

Applications, stating age, academic qualifications and experience, together with the names of three referees, should be received by 28th February, 1958, by the Registrar, from whom further particulars of the conditions of appointment may be obtained. E5015

### PENNSYLVANIA STATE UNIVERSITY

#### ASSISTANT PROFESSOR

Position available for ASSISTANT PROFESSOR to do research and teach Undergraduate and Graduate Courses in Engineering Mechanics. Someone with Doctor's Degree preferred.

Write, Joseph Marin, Department of Engineering Mechanics, the Pennsylvania State University, University Park, Pennsylvania, for further details. E9083

### CITY OF LIVERPOOL EDUCATION COMMITTEE

#### COLLEGE OF TECHNOLOGY

BYROM STREET, LIVERPOOL, 3

Acting Principal: J. E. MACFARLANE, B.Sc. (Eng.) (Lond.), M.I.E.E., A.M.I.Mech.E.

#### APPOINTMENTS

Applications are invited for the following appointments (full time) in the Department of Civil, Mechanical and Marine Engineering, which offers Advanced Courses in Civil, Mechanical, Production and Marine Engineering:—

(1) SENIOR LECTURER IN MECHANICAL ENGINEERING.

(2) LECTURER IN MECHANICAL or MARINE ENGINEERING.

(3) ASSISTANT, GRADE "B," IN MECHANICAL or MARINE ENGINEERING.

Salaries, Burnham Technical Report, viz.:
(Men) (1) £1350 by £50 to £1550 p.a.
(Men) (2) £1200 by £30 to £1350 p.a.
(Men) (3) £650 by £25 to £1025 p.a.

Assistants, Grade "B": to this scale, additional Graduate and training allowances, where applicable, will be paid. Increments up to a maximum of twelve may be allowed for professional or war service.

Applicants should possess good academic qualifications and in the case of Senior Lecturer and Lecturer, an Honours Degree in Mechanical or Marine Engineering is desirable, together with teaching, industrial or research experience. Equivalent qualifications will be considered where wide industrial, administrative or research experience could be applied to developments in the existing large department and in the new College which is under construction.

This is an opportunity to return to academic work whilst maintaining industrial contacts and developing research.

Consideration will be given to the appointment of registered disabled persons.

Further particulars and application forms (returnable by 15th March, 1958), may be obtained from the Director of Education, 14, Sir Thomas Street, Liverpool, 1.

THOMAS ALKER,
Town Clerk and Clerk to the Local Education Authority.

(J.5058) E6065

### LONDON COUNTY COUNCIL

#### WESTMINSTER TECHNICAL COLLEGE

#### LECTURER

Westminster Technical College, as soon as possible, LECTURER for Department of Civil Engineering. Should be a Graduate in Civil Engineering or Member of a Professional Institution. Subjects include Theory and Design of Structures to H.N.C. Level. Teaching experience an advantage. Burnham F.E. salary scale £1200 by £30 to £1350, plus London allowance.—Application forms from Principal at College, Vincent Square, S.E.1, to be returned by 21st February, 1958. (183.) E6046

### CIVIL SERVICE COMMISSION

#### THE ROYAL NAVAL COLLEGE, GREENWICH

#### PROFESSOR OF APPLIED MECHANICS

PROFESSOR OF APPLIED MECHANICS at the Royal Naval College, Greenwich. Pensionable post for man at least 31 on January 1st, 1958, with high academic qualifications in engineering with teaching and research or industrial experience. Duties, to commence in September, 1958, include lecturing, organisation of instruction and supervision of laboratories. Secondment from Scientific Civil Service considered. Salary £2500–£2800. Single accommodation may be provided.—Write, Civil Service Commission, Burlington Gardens, London, W.1, for application form, quoting No. 4808/58. Closing date 4th March, 1958. E6044

### UNIVERSITY OF EDINBURGH AND HERIOT-WATT COLLEGE

#### JOINT DEPARTMENT OF CHEMICAL TECHNOLOGY AND CHEMICAL ENGINEERING

#### APPOINTMENT

Applications are invited for either a LECTURESHIP or an ASSISTANTSHIP.

Lectureship: the initial salary will be at a point on the scale £900 to £1650 per annum, according to qualifications and experience. It is hoped to appoint a man who will be active in some field of chemical engineering research of his own choice.

Assistantship: the initial salary will be in the range £700 to £850 per annum. Teaching duties will not be heavy and the Assistant may engage in research for a Ph.D.

Both posts are subject to superannuation, and family allowance will be payable where applicable.

The successful applicant will be expected to take up duty on 1st October, 1958.

Applications will be considered from chemical engineers, physicists, chemists or mechanical engineers, or from mathematicians who have experience in applied science.

Further particulars may be obtained from the undersigned, with whom applications (four copies), giving the names of two referees, should be lodged not later than 24th March, 1958. (A candidate from overseas may submit one copy of this application.)

CHARLES H. STEWART,
Secretary to the University.
January, 1958. E6058

### ILFORD AND BARKING JOINT SEWERAGE COMMITTEE

#### CHIEF MAINTENANCE ENGINEER AT JOINT PUMPING STATION, ALFREDS WAY, BARKING

Salary A.P.T. II, £725 by £30 to £845 p.a., plus London weighting. A rent-free house valued at £39 p.a. for superannuation purposes is provided in addition.

Applicants should be qualified engineers possessing Ordinary National Certificate and having had indentured engineering pupil apprenticeship with subsequent training and extensive experience in both mechanical and electrical engineering, together with power plant operation and maintenance work and associated administrative duties.

The plant comprises a large electrically driven centrifugal and reciprocating hydraulic machinery and pressure pumping mains—diesel—electric generation plant; power-driven grinding mills; screening and excavator hoist installations; auxiliary equipment and instruments aggregating 4000 b.h.p.

The appointment is superannuable, subject to medical examination.

Applications, on forms obtainable from the Clerk to the Joint Committee, Town Hall, Ilford, Essex, should be submitted by the 22nd February, 1958. E6064

### CENTRAL WIRRAL GROUP

#### CLATTERBRIDGE HOSPITALS, BEBINGTON, CHESHIRE

(880 BEDS)

#### SENIOR ENGINEER

Applications are invited for the position of SENIOR ENGINEER from persons holding a recognised higher engineering qualification to standard of First Class Certificate of Competency in Marine Engineering or the equivalent Naval Certificate. Preference will be given to applicants possessing the Extra First Class Certificate of Competency in Marine Engineering or Higher National Diploma or Certificate in Mechanical Engineering (including Heat and Heat Engines and an endorsement for Electrical Installations).

Experience is desirable in site generation of electricity, laundry plant, sewage disposal plant, &c. The post carries responsibility to the Superintendent Engineer for the satisfactory co-ordination of the engineering and building maintenance services of the Clatterbridge Hospitals, the keeping of records and control of engineering and works staff.

Salary scale: £700 by £25 (3) by £30 (2) to £835 per annum (P.T.B. Circular 68).

Application forms, from the Group Secretary, Clatterbridge Hospital, Bebington, Cheshire, to be returned by 17th March, 1958. E5099

### MINISTRY OF SUPPLY

#### ROYAL RADAR ESTABLISHMENT, PERSHORE, WORCS

#### EXPERIMENTAL OFFICER

EXPERIMENTAL OFFICER required at Ministry of Supply, Royal Radar Establishment, Pershore, Worcs, for work on stress analysis and direction of mechanical tests associated with design approval of aircraft structural modifications necessary by installation of special equipments in various types of Civil and Military aircraft. Should have at least H.N.C. or equivalent and not less than 3 years' experience of stress problems associated with aircraft structures. Engineering apprenticeship or engineering experience an advantage. Appointment unestablished, but possibility of establishment through Civil Service Commission. Salary range £920–£1130 (male), minimum age 26 years.—Forms from M.L.N.S., Technical and Scientific Register, 26, King Street, London, S.W.1, quoting C.789/7A. E6009

### MANCHESTER CORPORATION WATERWORKS

#### ASSISTANT ENGINEERS

Applications are invited for the undermentioned engineering appointments on the temporary staff of the Corporation in connection with the design and execution of works included in (a) the Third and Fourth Instalments of the Haweswater Scheme, including the laying of 54in dia. steel pipes, and the construction of two service reservoirs (200 million gallons capacity) near Bury, Lancs, and (b) the filtration and treatment of the Longoendale supply.

ASSISTANT ENGINEERS (Class II). Salary in the range of £750/£1030 p.a., according to qualifications and experience.

Housing accommodation at a reasonable rental will be provided in certain cases.

Applications, stating (1) age, (2) education and training, (3) professional qualifications, (4) experience in the preparation of plans and construction of water works or other civil engineering works, together with the names of two referees, should be addressed to the Engineer and Manager, Waterworks Offices, Town Hall, Manchester, 2, so as to be received by the 21st February, 1958. E6051

### BRITISH RAILWAYS RESEARCH DEPARTMENT

#### DERBY

#### GRADUATE

Vacancy for GRADUATE in Vehicle and Track Division at Derby.

Design and development of instruments for use when measuring vehicle track forces and displacements. Workshop training very desirable.

Wide scope and opportunities. Salary range £646 to £956 per annum, but post-graduate experience will be considered, so that the selected candidate will not necessarily start on the minimum.

Free travel facilities.

Medical examination.

Applications, stating age, experience, &c., to Director of Research, British Transport Commission (British Railways Division), 222, Marylebone Road, London, N.W.1. E6004

### SHEFFIELD REGIONAL HOSPITAL BOARD

#### ASSISTANT ENGINEERS

ASSISTANT ENGINEERS required with particular experience in the design of heating and ventilating schemes in connection with steam and hot water services for large buildings. Applicants should be Corporate Members of the Institution of Heating and Ventilating Engineers or otherwise professionally qualified. Superannuation scheme, five-day week. Salary £700–£1015.—Applications, giving full details of training, experience, qualifications, &c., to be submitted to the Secretary to the Board, Fulwood House, Old Fulwood Road, Sheffield, 10, not later than 1st March, 1958. E6054

Classified Advts. continued on page 140

## PUBLIC APPOINTMENTS

### WANDSWORTH HOSPITAL GROUP
(COMPRISING FOUR HOSPITALS)

#### SUPERINTENDENT ENGINEER

Applications for post of SUPERINTENDENT ENGINEER are invited from engineers holding one of the following qualifications or equivalent :—
(1) First Class Certificate of Competency in Marine Engineering or equivalent Naval Certificate.
(2) City and Guilds full Technological Certificate in Plant Engineering (First Class).

Applicants must have completed an apprenticeship in general mechanical engineering or equivalent, and should be experienced in maintenance and operation of major central boiler plants and ancillary equipment, and capable of supervision of new installations. The successful applicant will be responsible for the organisation and supervision of the maintenance of all engineering services in the Group, for the efficient operation of all plant and for keeping of technical records. Whitley Council conditions of service apply. Salary scale £855 by £25 (2) by £30 (1) by £35 (2) to £1005, plus London weighting.—Applications, stating age, qualifications, experience and three referees, to the Group Secretary, St. James' Hospital, Balham, S.W.12. E6000

### COVENTRY CORPORATION

#### CIVIL AND STRUCTURAL ENGINEERING SECTION

#### ASSISTANT ENGINEERS

Coventry Corporation require the following staff in Civil and Structural Engineering Section of City Engineer's Department :—

(a) SENIOR ASSISTANT ENGINEERS—Grade A.P.T. V (£1175–£1325), commencing according to qualifications/experience. A.M.I.Struct. E. or other suitable qualification, and considerable experience design, detailing and construction reinforced concrete and steel structures essential.

(b) ASSISTANT ENGINEERS—Grade A.P.T. III or Special, £750–£1036, commencing according to qualifications/experience ; £26 Local Award also paid on salaries up to £795. Experience design and detailing reinforced concrete and/or steel structures essential.

These appointments are in connection with a number of important projects planned for early commencement as part of City Redevelopment Programme. They are permanent appointments offering ample scope for interesting and varied structural work. Housing accommodation may be available.—Application forms from City Engineer, Council House, Coventry, returnable by 19th February. E6069

### UNITED KINGDOM ATOMIC ENERGY AUTHORITY

#### DOUNREAY WORKS, THURSO, CAITHNESS, SCOTLAND

#### MECHANICAL ENGINEER

The Operations Branch of the United Kingdom Atomic Energy Authority, Industrial Group, requires an ENGINEER at Dounreay Works, Thurso, Caithness, Scotland, to be responsible for the mechanical engineering services associated with a group of research laboratories. The work will cover a wide field with particular emphasis on the manufacture and installation of prototype equipment for research projects, the adaptation of standard equipment for unusual duties and the planned maintenance of installed plant. Close liaison with research staff is involved.

A recognised engineering apprenticeship, Corporate Membership of the Institution of Mechanical Engineers, or equivalent qualifications, and managerial experience are essential. Experience of chemical plant and industrial laboratories, together with precision engineering and general design work, is desirable.

Salary assessed within scale £1300–£1740 p.a. Contributory pension scheme.

A house at Thurso or hostel accommodation may be available. Substantial assistance towards removal expenses is given in certain cases.

Send postcard for application form, quoting reference 2233, to Works Secretary, Dounreay Works. Closing date : 24th February, 1958. E5095

#### LIGHTHOUSE AND BUOYAGE ENGINEER

#### NIGERIAN PORTS AUTHORITY

Nigerian Ports Authority, a recently created public corporation, invites applications from suitably qualified candidates for the post of LIGHTHOUSE AND BUOYAGE ENGINEER. Applicants, preferably under 45 years of age, should have had wide experience in the maintenance of lighthouse equipment and mechanism, both gas and electric, and of the maintenance of large ocean and river light buoys and light beacons ; electrical knowledge and experience would be of advantage. Salary in range £1200 to £1650, plus £300 per annum overseas pay (where applicable). Appointment would be for one tour in first instance and, thereafter, subject to satisfactory service, on permanent basis. Non-contributory pension fund. Tour normally 12/18 months. Leave on basis of 7 days for every completed month of service. Free first-class passages for officer and wife. Additional passages and allowance for children. Furnished accommodation provided at reasonable rental. —Write the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience, and quote M2A/42610/EH. E6019

## PUBLIC APPOINTMENTS

### BRITISH RAILWAYS (SCOTTISH REGION)

#### WORK STUDY SCHOOL, GLASGOW

#### ASSISTANT INSTRUCTOR, SCOTTISH REGION

Applications are invited for the post of ASSISTANT INSTRUCTOR, Scottish Region Work Study School.

Conversant with work study techniques and should preferably have lecturing experience. Will be required to assist in organising Work Study Courses and preparing outside projects. Salary £1120, rising to £1285 per annum.

Applications, in writing, giving age, education, experience and qualifications, should be addressed to the General Manager, British Railways, 302, Buchanan Street, Glasgow, C.2. E5096

## TENDERS

### SCOTTISH HOME DEPARTMENT

#### COUNTY OF ARGYLL

#### TARBET-INVERARAY-LOCHGILPHEAD-OBAN TRUNK ROAD A.83 LOIN BRIDGE TO BLACK SPOUT

#### CONTRACT NO. A.2A

The Secretary of State invites TENDERS for the COMPLETION of the RECONSTRUCTION of the Tarbet–Inveraray–Lochgilphead–Oban Trunk Road, comprising sections at Loin Bridge and Black Spout—a total of approximately 3·6 miles of new or reconstructed road.

Contract documents and further information obtainable from The Chief Road Engineer, Scottish Home Department, Bankhead Avenue, Sighthill, Edinburgh, 11, upon payment of a deposit of £10 by cheque or draft made payable to the Queen's and Lord Treasurer's Remembrancer. Deposit refunded if a bona-fide Tender is submitted and not subsequently withdrawn.

The drawings may be inspected at the offices of the Scottish Home Department (Roads Division), Glenshellach Road, Oban, and of the Chief Road Engineer, Scottish Home Department, Bankhead Avenue, Sighthill, Edinburgh, 11.

Tenders, on the official form, which must be received before 4 p.m. on 27th March, 1958, should be sent in a sealed registered envelope marked "Tender for Road Works, Contract No. A.2A," to the Secretary, Scottish Home Department, Broomhouse Drive, Saughton, Edinburgh, 11.

The Secretary of State does not bind himself to accept the lowest or any Tender. E6035

### NEW ZEALAND GOVERNMENT MINISTRY OF WORKS

#### NANDI INTERNATIONAL AIRPORT, FIJI

#### RECONSTRUCTION AND EXTENSION OF AIRPORT FACILITIES

The Ministry of Works of New Zealand proposes to call for TENDERS for the RECONSTRUCTION and EXTENSION of AIRPORT FACILITIES at Nandi Airport, Fiji. Major works comprise extension in concrete of the main runway by approximately 4000ft. and resurfacing approximately 6700ft. of this runway by overslabbing in concrete, strengthening part of a second runway and resurfacing the whole of this runway in bitumen, the construction of a concrete apron and taxiway and carrying out ancillary works. All work is required to be complete by 31st December, 1959. A preliminary statement outlining the work involved and including a questionnaire as to capacity is available to bona-fide contracting organisations who make application to the New Zealand Government Offices in London (tel.: TRA 8030, Ext. 6), Melbourne and Sydney and at Ministry of Works Offices at Laucala Bay, Suva and Government Buildings, Wellington, New Zealand. The information sought in the questionnaire must be returned to the Secretary of the Tenders Board, Ministry of Works, Box 8015, Government Buildings Post Office, Wellington, New Zealand, by 28th February, 1958. Specifications and drawings, with a formal invitation to Tender, will be issued to contracting organisations who can satisfy the requirements envisaged in the questionnaire. No further advertisement will be made. This advertisement and the preliminary statement and questionnaire will not form part of the contract. E6020

### AUCKLAND HARBOUR BOARD

#### NEW ZEALAND

#### TENDERS FOR CONSTRUCTION OF FREYBERG WHARF

TENDERS are invited for the CONSTRUCTION of a REINFORCED CONCRETE PILED WHARF, having berths for two overseas ships and comprising 24,300 sq. yds. of reinforced concrete deck, steel sheet pile breastworks, stone banks, formation of approaches and services at Auckland, New Zealand.

Contract documents and plans may be obtained from Auckland Harbour Board, Auckland, New Zealand, or William Coward and Co., 3, St. James's Square, London, S.W.1.

Tenders close at Auckland 30th June, 1958.

V. A. C. CHRISTIANSEN, Secretary.

E5093

## TENDERS

### CITY OF BAGHDAD

#### BAGHDAD SEWERAGE BOARD

#### BAGHDAD DRAINAGE—CONTRACTS IA, ID AND IC

TO CIVIL ENGINEERING CONTRACTORS.

THE BAGHDAD SEWERAGE BOARD invites TENDERS for the CONSTRUCTION of the CIVIL ENGINEERING WORKS of the FIRST STAGE of the BAGHDAD SEWERAGE SCHEME.

The works to be constructed comprise three Contracts and Contractors may submit Tenders for any one, any two, or all three of the individual Contracts. The conditions of contract, specification, bills of quantities, form of Tender, &c., for all three Contracts are contained in the same Tender document.

The works to be constructed in the individual Contracts are :—

CONTRACT IA.—The first stage of the Soiada Sewage Treatment Works for a population of 300,000 persons and including pumping stations, settlement tanks, channels, outfall, sludge digestion tanks, power house and ancillary works.

CONTRACT IB.—Approximately 11km. of Trunk Sewer between 1·85m. and 2·3m. diameter, 14 Sewage Pumping Stations and short lengths of 0·6m. and 0·75m. diameter Sewers and Associated Pumping Mains.

CONTRACT IC.—Approximately 170km. of Pipe Sewers between 22·5cm. and 45cm. diameter, together with associated Pumping Mains, laterals for house connections and ancillary works. (Note : In certain circumstances Tenders for shorter lengths of sewers and associated works will be considered.)

The Tender document and contract drawings may be inspected during normal working hours after January 6th, 1958, at the offices of the Baghdad Sewerage Board, Baghdad, at the Royal Iraqi Embassies in Rome and Washington, at the Royal Iraqi Legations in Brussels, and Rome, and at the offices of the Consulting Engineers, John Taylor and Sons, Artillery House, Artillery Row, London, S.W.1, and 464, Alwiyah, Baghdad (telephone No.: Baghdad 98736).

Copies of the Tender Document and Contract Drawings may be obtained from any of the abovementioned addresses on payment of ID. 20 (Twenty Iraqi Dinars) or £20 (Twenty Pounds Sterling). This payment will not be returnable and must be made by cheque or Banker's draft, payable to the Consulting Engineers.

The Tenders shall be in English and must be accompanied by a deposit of I.D. 10,000 (Ten Thousand Iraqi Dinars), either in cash or by a letter of guarantee from an approved Bank in Iraq. The Tenders accompanying documents must be enclosed in a sealed package which shall not in any way indicate the name of the Tenderer and must be delivered in Baghdad in accordance with the instructions contained in the document by 12 o'clock noon, local time, on the 1st day of June, 1958.

During the time allowed for Tendering, the Baghdad Sewerage Board reserves the right to amend the documents for the purposes of clarification or modifications in design or contract conditions. Any such amendments will be notified in writing to prospective Tenderers.

The Baghdad Sewerage Board does not bind itself to accept the lowest or any Tender.

FAKHRI AL FAKHRI,
Chairman of the Baghdad Sewerage Board.
E9699

ADVERTISEMENT No. 12

### CITY OF BAGHDAD

#### BAGHDAD DRAINAGE—MACHINERY CONTRACT NO. M.2

TO MANUFACTURERS OF CENTRIFUGAL PUMPING PLANT

The Baghdad Sewerage Board invites TENDERS for the MANUFACTURE, ERECTION ON SITE and COMMISSIONING of the following equipment :—53 ELECTRICALLY DRIVEN CENTRIFUGAL UNCHOKEABLE SEWAGE PUMPING UNITS in seventeen stations, complete with Auxiliaries, Control Gear and Wiring. The capacity of individual pumping units will depend on the location, but the smallest is 125 and the largest 15,000 Imperial gallons per minute.

The Tender documents and contract drawings may be inspected during normal working hours after February 4th, 1958, at the offices of the Baghdad Sewerage Board, Baghdad, at the Royal Iraqi Embassies in Bonn and Washington, at the Royal Iraqi Legations in Brussels and Rome, and also at the offices of the Consulting Engineers, John Taylor and Sons, Artillery House, Artillery Row, London, S.W.1, and 464, Alwiyah, Baghdad (Tel. 98736).

Copies of the Tender documents and contract drawings may be obtained from any of the abovementioned addresses on payment of I.D. 20 (twenty Iraqi Dinars) or £20 (Twenty Pounds Sterling). This payment will not be returnable and must be made by cheque or Banker's draft payable to the Consulting Engineers.

The Tenders shall be in English and must be accompanied by a deposit of I.D. 5000 (Five Thousand Iraqi Dinars), either in cash or by a letter of guarantee from an approved Bank in Iraq. The Tenders and accompanying documents must be enclosed in a sealed package which shall not in any way indicate the name of the tenderer and must be delivered in Baghdad in accordance with the instructions contained in the documents by 12 o'clock noon local time on the 1st day of June, 1958.

During the time allowed for tendering the Baghdad Sewerage Board reserves the right to amend the documents for the purposes of clarification or modifications in design or contract conditions. Any such amendments will be notified in writing to prospective tenderers.

The Baghdad Sewerage Board does not bind itself to accept the lowest or any Tender.

(Signed) FAKHRI AL FAKHRI,
Chairman of the
Baghdad Sewerage Board.
E5091

## EDUCATIONAL

### THE INSTITUTION OF CIVIL ENGINEERS

#### ROCKEFELLER FOUNDATION BURSARIES

A number of ROCKEFELLER FOUNDATION BURSARIES from about £450 to about £700 for post-graduate study or research in Public Health Engineering are available for the academic year 1958/59. Further details and application forms are obtainable from the Secretary of the Institution, Great George Street, London, S.W.1. Closing date for applications is 31st March, 1958. E6016 B

### TECHNICAL HOME STUDY COURSES

For A.M.I.Mech.E., A.M.I.Chem.E., A.M.I.M.I., A.F.R.Ae.S., C. & G., &c.

OVER 50 FIRST PLACES and more than 2000 Passes have been secured by T.I.G.B. Students at Professional Engineering Examinations. We have a wide range of exclusive Home Study Courses in all branches of Engineering—Mechanical, Electrical, Aeronautical, Automobile, Chemical, Gas, Radio, and Television, Draughtsmanship, &c. Textbooks, blueprints, &c., are provided and, if desired, fees may be paid by moderate instalments.—Write (stating subject of interest) for copy of 110-page Prospectus FREE and without obligation.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN
(Dept. 76),
29, WRIGHT'S LANE, LONDON, W.8.
E102 B

**A.M.I.MECH.E., B.Sc.,** City and Guilds, &c. Guarantee Postal Courses for all Exams., and Technical Divisions from Elementary to Degree standard. Approximately 95 per cent. successes. 144-page prospectus free on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E721 B

**FREE !** Brochure giving details of Courses in Mechanical and Production Engineering, Draughtsmanship, &c., for the A.M.I.Mech.E., A.M.I.P.E., City and Guilds and other professional examinations. —E.M.I. Institutes, Dept. E.30, London W.4. (Associated with H.M.V.). E972 B

## SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES, NOT ORIGINALS, OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED

**A DESIGNER** is required by Texaco Trinidad, Incorporated, in connection with its oil-producing and refining operations in Trinidad, B.W.I.

Applicants should have at least 3 years' experience of drawing-office design and 2 years of construction work, and have a University Degree or Associate Membership of a professional institution. The successful applicant will work under the direction of the Design Engineer in a section of the drawing-office appropriate to his qualification, which may be in civil, structural or mechanical engineering. This pensionable and progressive appointment entails supervision of several draughtsmen and should appeal to a man aged not more than 35 and earning up to £1300 per annum in this country.

Please write, with brief particulars, to the Personnel Officer, Trinoil (U.K.), Limited, Trinidad House, Old Burlington Street, London, W.1. E5094 A

**A JOB AND A HOME**

DESIGNER AND DETAIL DRAUGHTSMEN
wanted for
Hydraulic Press,
General Engineering
and
Boiler Divisions
No Age Limit

Pleasant and comfortable houses provided for successful applicants and profit-sharing scheme.

Applicants with suitable training and experience for the above requirement, apply to :
The Personnel Officer,
Foster Yates & Thom, Ltd.,
Heavy Precision Engineers,
Blackburn.
E9978 A

**A LEADING BRITISH COMPANY** in Malaya requires MECHANICAL ENGINEER. Minimum qualifications : H.N.C. and/or Grad.Mech.E. standard, or apprenticeship with studies of O.N.C. standard ; experience on diesel engines ; electrical experience would be an advantage. Duties will include engineering office administration, technical sales, service liaison, testing and installation of machinery, and market surveys. Age limits 24–30, preferably single. Initial remuneration according to age and experience. Annual contractual increments. Annual bonus out of profits. Car allowances and interest-free facilities for car purchase. Accommodation provided at nominal rent. Local leave, home leave on full pay on satisfactory completion of tour. First-class passages provided.—Apply, with full details, to BOX No. W1430, Haddon's, Salisbury Square, London, E.C.4. E6001 A

**ARE YOU AN ENGINEER,** age 20–30, with an interest in selling ? An expanding medium-sized organisation, presently supplying the international oil and petroleum industry, is looking for a young ENGINEER for Representation in the field after an inside period of familiarisation with products and methods. An excellent opportunity for a young man to join young and progressive company. Write, giving full details, qualifications, experience, &c.—BOX No. E1601, "The Engineer." A

## SITUATIONS VACANT

**A MANUFACTURER** of light precision engineering sub-components with 40 employees and plans for expansion, seeks for his modern factory in Sussex a

WORKS MANAGER

Engineers with management experience, aged 27–40, and tool-room small mechanisms radio valve manufacture or work study background who are temperamentally suited to atmosphere of small dynamic firm and interested in starting salary of about £1200 with good prospects, write briefly in confidence to :

Managing Director (WW.84),
EXECUTIVE APPOINTMENTS, LIMITED,
67, Wigmore Street, London, W.1.
E6061 A

**AN EXPANDING COMPANY** of drawing-office equipment and office machinery manufacturers situated in pleasant surroundings in the Eastern Counties, require THREE DRAUGHTSMEN in their production drawing-office for the preparation and production of drawings from designers' schemes and prototypes. Experience in quantity production of sheet metal work and layout of electrical wiring diagrams for light machines an advantage, but not essential. A.E.S.D. rates and above paid. Applicants over 40 years of age accepted. Superannuation scheme in operation. Canteen facilities available.—Write, giving full details of experience, to Personnel Officer, E. N. Mason and Sons, Ltd., Arclight Works, Colchester, Essex. E6027 A

**APPLICATIONS** are invited from ENGINEERS possessing University Degree, and having thorough general knowledge of mechanical and electrical engineering, by a company engaged in the sale of heavy engineering and electrical products. Salary according to qualifications, £2000–£2500 p.a. The position offers for applicants with initiative and administrative ability scope for promotion to Deputy of the Managing Director.—Please apply, stating qualifications and experience, to the Managing Director, W. Wykeham and Company, Limited, 17/19, Cockspur Street, London, S.W.1. E6012 A

**BRITISH ENGINE BOILER AND ELECTRICAL INSURANCE CO., LTD., 24, FENNEL STREET, MANCHESTER, 4**

INSPECTORS OF BOILER AND ENGINE PLANT required for various districts. Permanent positions carrying progressive salary scale £735 to £1060 and non-contributory pension. Candidates, age not exceeding 32 years, having steam boiler and engine experience and possessing at least First Class M.O.T. Certificate, are invited to apply in own handwriting, stating age, qualifications and experience. E6067 A

**BLACKBURN AND GENERAL AIRCRAFT LIMITED**

**BLACKBURN (DUMBARTON) LIMITED**

**PROJECT ENGINEERS**

**DESIGNERS**

**SENIOR AND JUNIOR DRAUGHTSMEN**

Blackburn (Dumbarton) Limited are developing new lines of business in the Structural, Mechanical and Electrical Engineering fields.

Project Engineers, Designers, and Draughtsmen with experience in Light Structures, Aircraft and Marine Servicing Equipment, Aerodrome Equipment, &c., or experience which they can adapt to these branches of Engineering, are invited to apply for positions in the new Design Office.

Designers, Draughtsmen and Stressmen are also required for the Dumbarton Aircraft Design Office of Blackburn and General Aircraft Limited, which has a long programme of work on advanced high speed jet aircraft and in the development of freighter and transport aircraft.

Excellent working conditions, contributory Pension and Free Life Assurance schemes in operation.

Applications to be addressed to :

THE PERSONNEL MANAGER

BLACKBURN (DUMBARTON) LIMITED

CASTLE ROAD

DUMBARTON E5040 A

**CHIEF DRAUGHTSMAN** required by a large engineering company to take charge of their London design offices, situated in the West End. The successful applicant must have very sound experience of mechanical and/or structural engineering, and be an A.M.I.Mech.E., also able to administrate a staff of 17 men, and negotiate with customers and potential customers.—Please apply, with full particulars, quoting " Director," to BOX No. E9749, " The Engineer."

**CIVIL AND STRUCTURAL ENGINEERS AND DRAUGHTSMEN** required for permanent appointments, preferably with experience in reinforced concrete. Attractive salaries paid and, in many cases, accommodation allowance. Positions which attract accommodation allowance may involve periodic changes of location. Reply, giving full details of age, experience, qualifications, &c.—BOX No. E6021, " The Engineer." A

**CALTEX PACIFIC OIL COMPANY MECHANICAL ENGINEER**

Applications are invited for this position in Sumatra, where the company is developing new oilfields in jungle areas.

Candidates, not over forty years of age, must have attained A.M.I.Mech.E. and have ten or more years' experience in the design and installation of small tank farms and gathering station pumphouses, generating plants, workshops, and of the pipe runs and manifolds connected therewith. Their experience should preferably include similar work in an oilfield.

A salary commensurate with qualifications and experience can be offered in addition to which adequate living allowances are given with medical attention, paid local and home leave and participation in pension plan.

Please write, giving full particulars and quoting " SUM." to Caltex Services, Limited, Caltex House, Knightsbridge Green, London, S.W.1. E5067 A

**CIVIL ENGINEERS FOR THE OIL INDUSTRY**

Applications are invited from Civil Engineering Graduates not over 30 years of age, for positions initially in our London office, to be followed by overseas assignment in six to twelve months' time.

Candidates should have a minimum of three years' experience since Graduation principally in design in all phases of civil engineering as applied to buildings, roads, sewers, wharves, jetties and general construction projects.

A good salary can be offered, according to qualifications and experience, with pension plan benefits, &c.

Apply, quoting " LON," to :
CALTEX SERVICES LIMITED,
CALTEX HOUSE,
KNIGHTSBRIDGE GREEN,
LONDON, S.W.1. E5050 A

**CIVIL ENGINEER** is required as Assistant Resident Engineer on colliery reconstruction scheme. Graduate or exemption from Parts A and B of the Institution's examinations desirable. Age 24–30. Apply, with full particulars in confidence, quoting reference CE.58.—BOX No. E9999, " The Engineer." A

**C. AND J. CLARK, LIMITED,** Shoemakers, of Street, Somerset, require a MAINTENANCE ENGINEER to take charge of purchase, installation and maintenance of 2000 industrial sewing machines and 25 maintenance staff in their factories throughout Somerset. Account will be taken of personality, engineering qualifications and experience. Salary not less than £800 p.a. Applicants must have previously had control of labour ; age 25–40. The successful applicant will be required to live in or near Street.—Applications should be made to the Personnel Director, C. and J. CLARK, LIMITED, Street, Somerset, marking your applications " Private." E6050 A

**CONTRACT ENGINEERS.**—Vacancies exist in firm of civil engineering designers and contractors for qualified CIVIL ENGINEERS to act as Contract Engineers. Contracts include erection of reinforced concrete buildings and site as well as design experience in such work is desirable. Age between 25 and 35. Salary according to qualifications and experience. These are permanent posts and staff pension and sick pay schemes apply.—Please give full details, which will be treated in confidence, to Contract Labour Division, Personnel Department, Simon-Carves, Ltd., Cheadle Heath, Stockport. E5000 A

**DEPUTY** required for the Mechanical Superintendent of an open-cast mining establishment in West Africa. A man with a wide background of mechanical experience in repair, maintenance, organisation and supervision of engineering activities required. The company's interests include ore-handling facilities and conveyors, a railway with diesel traction, earth-moving equipment, &c. Salary in the region of £1800 p.a., according to experience. Marriage and children's allowances, contributory pension and dependents' income schemes, free furnished accommodation and medical attention.—Write, giving full details of experience, stating age, married or single, to BOX TE.947, c/o 191, Gresham House, E.C.2. E6036 A

**DESIGN ENGINEER,** with wide experience of electro-hydraulic mechanisms, required by a substantial firm of engineers in the WINDSOR/SLOUGH area. The person appointed will be required to work from the drawing board and must be an accomplished draughtsman. He will be required to initiate new designs and take full responsibility for development of light electro-mechanical and hydraulic mechanisms. Commencing salary will be £1200, plus production bonus. The appointee will hold executive rank, and be directly responsible to the Chief Engineer. A superannuation scheme is in operation.—Please send applications with full details of experience to BOX TE. 950, c/o 191, Gresham House, E.C.2. E6055 A

**DESIGNER-DRAUGHTSMEN,** preferably experienced in design of jib cranes, &c. The positions offered are due to expansion of the firm's activities, would be permanent, progressive and would carry salaries commensurate with experience. Pension scheme, 5-day week.—

Apply :
Chief Engineer,
Clyde Crane and Engineering Co.,
Mossend,
Nr. Motherwell. E9976 A

**DRAUGHTSMAN (SENIOR),** having experience in machine design and works layouts. A knowledge of works building design desirable, but not essential. Technical education to at least O.N.C. standard. DRAUGHTSMAN (JUNIOR) for general engineering design or jig and tool design.—Applicants are invited to submit full details of age, experience and salary required, to the Personnel Manager, Ferodo, Limited, Chapel-en-le-Frith, Via Stockport. E6056 A

**DESIGNER-ESTIMATOR** required by a well-established firm of Sewage Pump manufacturers in the Midlands. Successful applicant would be engaged upon the design, development and estimating for centrifugal sewage pumps and accessories. Replies should give the usual personal particulars, together with details of previous experience and salary required.—BOX No. E1575, " The Engineer." A

**DRAUGHTSMEN,** Seniors and Juniors, required by marine engine works on Tyne for engine-room layouts, engine and boiler details. Applications will be considered from marine engineers with suitable qualifications. Apply giving age and experience.—BOX No. E9997, " The Engineer." A

**DRAUGHTSMEN** required in the following categories : Senior and Junior Piping and Instrumentation ; Senior Mechanical, by Engineers in City engaged on nuclear/petroleum/chemical plants. H.N.C./O.N.C. desirable. Salaries above average. 5-day week, pension/life assurance and personal accident schemes, house purchase assistance, luncheon vouchers.—Write full particulars to Head Wrightson Processes, Ltd., 24/26, Baltic Street, E.C.1. E954 A

**DRAUGHTSMEN.**—Midland Silicones, Limited, have vacancies which offer the opportunity of gaining experience on modern chemical process plant. Previous chemical plant experience is not required, but an engineering apprenticeship and O.N.C. are desirable. Positions are permanent and a non-contributory pension scheme is in operation.—Reply, stating age, qualifications and experience, to Works Engineer, Midland Silicones, Limited, Barry, Glamorgan. E1602 A

**DRAWING OFFICE CHECKER** required. Skilled. Good experience in general mechanical engineering.—Apply, Personnel Manager, Blaw Knox, Ltd., Esplanade, Rochester, Kent. E1576 A

**ELECTRICAL AND/OR MECHANICAL ENGINEERING GRADUATES** required by large Australian Mining Company operating in Queensland. Minimum starting salary £1210 (Australian) per annum, plus variable lead bonus at present £4 7s. 6d. per week. Free travel to Australia. Experience in the repair, maintenance and construction of mining, milling, smelter and power generating equipment will be gained. Single or married accommodation available.

Apply to : Secretary,
Mount Isa Mines, Limited,
Adelaide House,
King William Street,
London, E.C.4. E5089 A

**ENGINEERING INSURANCE COMPANY** invites applications from Engineers, not over 35 years of age, who possess First Class M.O.T. Certificate (Steam) for position as ENGINEER SURVEYOR in London and surrounding districts. Progressive salary scale commencing at £735 and rising to over £1000 per annum, plus expenses and allowances. Non-contributory pension scheme and other staff schemes. Apply in own handwriting.—BOX No. E6022, " The Engineer." A

**ENGINEER/SURVEYORS** required immediately for medium-size road and sewer contracts in London area and Essex. Good prospects for young men.—Write, in confidence, The Secretary, Fitzpatrick and Son (Contrs.), Ltd., 455, Old Ford Road, Bow, London, E.3, stating age, experience, salary required, &c. E1596 A

**EXECUTIVE APPOINTMENTS, LIMITED,**

acting on behalf of
a leading manufacturer of small mechanisms, invite applications for two appointments as

(1) MECHANICAL ENGINEER
(2) ELECTRICAL ENGINEER

in the company's research and sales division on the southern outskirts of London.

Men aged about 30, attracted by service in a progressive organisation which offers a starting salary in the range £800–£1000 and good prospects are invited to apply if they have appropriate technical qualifications above H.N.C. standard and practical experience in the case of (1) of design or manufacture of small mechanisms and in the case of (2) of electronics or light electrical engineering. Candidates must have enquiring minds and qualities of sound judgment and initiative.

Write briefly within 7 days, in the assurance that names will not be divulged to the employer without permission, to :

The Managing Director (RV.83),
EXECUTIVE APPOINTMENTS, LIMITED,
67, Wigmore Street, London, W.1.
E6062 A

**FORD MOTOR COMPANY, LIMITED**

Applications are invited for the following vacancies :—

ASSISTANT ENGINEER IN CHARGE

Experience in the efficient operation of turbo-alternators and large pulverised-fuel-fired, high-pressure boilers is required. A sound technical engineering training is essential. (Reference T.A.E.)

ENGINEERING ASSISTANT

Applicants should be familiar with power station efficiency control and operating statistics. The duties will also include assessing the economics of plant development schemes associated with power production. (Reference TEP.)

Salary in accordance with experience and qualifications. Generous non-contributory pension scheme.—Please write to Training and Recruitment Department (012A), Ford Motor Company, Ltd., Dagenham, Essex, giving details of age, experience and qualifications, and quoting appropriate reference. E6066 A

Classified Advts. continued on page 142

## BOOKS and PUBLICATIONS


*"A complete library in two volumes.."*

# KEMPE'S

## Engineers Year Book

*Edited under the direction of the Editor of "The Engineer"*

**1958 (63rd Edition)**

**82/6** (plus postage 2/6d.)

**JUST PUBLISHED**

★ **3,000 pages covering modern theory and practice in all branches of engineering. No other single publication devoted to engineering covers a comparable range of subjects so concisely.**

**ORDER YOUR COPY NOW**

Obtainable direct from the publishers or through your local booksellers

**Kempe's Engineers Year - Book**
28 Essex Street, Strand, London, W.C.2
*Telephone:* Central 6565

## SITUATIONS VACANT

**EXPERIENCED DRAUGHTSMEN,** of O.N.C. or H.N.C. standard, required for interesting design work on process plant and machinery. A good technical background and knowledge of machine design is essential and applicants should be qualified to H.N.C. standard. Salaries are assessed in accordance with age, qualifications and experience, and will be reviewed annually. Contributory superannuation and widow's pension fund are in operation and there are excellent canteen, welfare and recreational facilities.—Applicants should apply in writing to Group Personnel Department, Pilkington Brothers, Limited, Grove Street, St. Helens, enclosing a brief history of their career and details of their education and qualifications. E6047 A

**EXPERIENCED YOUNG ENGINEER SEEKS DIRECTORSHIP** with investment up to £15,000 in private company, precision or electronic engineering automation, applications in new industries, &c. Southern England preferred.—Write, BOX E 680, L.P.E., Romano House, 399/401, Strand, W.C.2. E5051 A

**GAS TURBINE DESIGN ENGINEER** required for work on industrial and marine sets. The work includes thermodynamic design of compressors and turbines, cycle assessment, performance prediction, heat transfer calculations and major stressing.

Applicants should hold University Degree or equivalent, but previous experience of gas turbines is not essential.

Good pension scheme, excellent amenities and assistance towards moving.

Applications, stating qualifications, experience and salary required, should be made to The Personnel Manager,
W. H. ALLEN, SONS AND CO., LTD.,
QUEENS ENGINEERING WORKS,
BEDFORD. E6052 A

**GOSS PRINTING PRESS COMPANY, LIMITED,** have a vacancy at the London office for a

SENIOR DRAUGHTSMAN

with experience in the design of rotary printing presses. A generous staff pension and life assurance scheme is in operation, and a bonus is paid annually. Salary will be paid in accordance with experience and ability.

Please supply full details of age and experience to Personnel Manager, Greenbank Street, Preston. E6028 A

**INDUSTRIAL FURNACE CONSTRUCTION COMPANY,** engaged principally in Iron and Steel Industry on construction of Open Hearth Steel Furnaces, Soaking Pits, Rotary and Annealing Furnaces, &c., and Blast Furnace Linings, require the following staff.

SITE AGENTS. Age 30 to 40 years. Salary from £1000.

JUNIOR SITE AGENTS. Age 23 to 30 years.

Applicants should be qualified engineers with Iron and Steelworks experience. These are permanent appointments with participation in pension scheme after probationary period. Salary commensurate with qualifications and experience, plus bonus. Suitable transport will be provided for Site Agents.

Applications, giving personal details, qualifications and experience.—BOX No. E5025, "The Engineer." A

**INSTRUMENTATION DESIGNER-DRAUGHTSMEN** required in the Middlesbrough area. Attractive salary and allowances. Pensionable appointments.—BOX No. E6060, "The Engineer." A

**JUNIOR DRAUGHTSMAN** required, experience in mechanical handling plant an advantage. Good prospects.—British Industrial Sand, Ltd., High Street, Godstone, Surrey. E1608 A

**JUNIOR INSTRUMENT DRAUGHTSMEN,** having completed National Service, required for work on large chemical plant installations. A.E.S.D. minimum rates or above. Five-day week and superannuation scheme.—Apply by letter, giving details of technical education to the Chief Draughtsman, Laporte Chemicals, Limited, Clifton House, Euston Road, London, N.W.1. E9988 A

**LADY TRACER,** Junior or Assistant, required by scientific society to prepare illustrations for reproduction. Five-day week; Belgravia.—BOX No. E1603, "The Engineer." A

**MECHANICAL ENGINEER** required by large Australian Mining Company operating in Queensland.

Salary up to £2000 (Australian) p.a., plus variable lead bonus at present £4 7s. 6d. per week. Free travel to Australia.

Applicant is required to have up to 8–10 years' experience in industrial plant repair maintenance and construction. Corporate Member of the I.M.E. is preferred, but a Graduate Member will be considered.

The plant comprises a power station of 27·5MW capacity and large and varied plant in mining, milling and smelting equipment.

A large expansion programme at present being undertaken, including a 30MW power station and extensions to existing plant to give double present output.

Apply: The Secretary,
Mount Isa Mines, Limited,
Adelaide House,
King William Street,
London, E.C.4. E5090 A

**MECHANICAL AND ELECTRICAL ENGINEER** required by Howard Humphreys and Sons, to supervise large installation of dual-fuel engines and generators, pumping plant, mechanical scrapers and electrical distribution system, &c., at Reading Sewage Disposal Works. Initial salary within the Reading Corporation Scale, A.P.T. Grade V (£1175–£1325), according to qualifications and experience.—Full details to Victoria Station House, Victoria Street, Westminster, quoting reference 372. E1581 A

**MECHANICAL DESIGN DRAUGHTSMAN** required, Manchester district, for a responsible position in connection with an atomic energy project. Experience in the design of pressure vessels and associated pipework essential; a knowledge of the estimating of this type of equipment will be an advantage. Candidates should possess at least an H.N.C. in Mechanical Engineering. An attractive salary, commensurate with experience and qualifications, will be available. Apply, in confidence, stating age, experience, &c.—BOX No. E6039, "The Engineer." A

**MECHANICAL ENGINEERING DRAUGHTSMAN** required, with experience of design and setting out of stone aggregate handling, asphalt, and quarry plants, required to work in Greenwich area. Good commencing salary. Apply, giving details of experience.—BOX No. E1597, "The Engineer." A

**NATIONAL ESTABLISHED CONSULTING ENGINEERS** require SENIOR DRAUGHTSMEN, qualified and experienced in crane design and detail, for assignments in West Midlands and West Scotland. Salary plus expense allowance £850–£950 p.a.—Reply with personal details to BOX No. E9868, "The Engineer." A

**NATIONAL ESTABLISHED CONSULTING ENGINEERS** require SENIOR DESIGNER DRAUGHTSMEN in the London area, for Electrification Schemes in Heavy Industry. Salary, including London allowance, £875/£1000 p.a., according to experience and qualifications. Optional pension scheme.—BOX No. E9900, "The Engineer." A

**C. A. NORGREN, LTD.,** and Associate Companies invite applications for a post as a TECHNICAL REPRESENTATIVE in the London area for their range of compressed air equipment and for Sundstrand pneumatic sanders. Engineering and sales experience, together with a clean driving licence, are essential for this position, which carries a salary with commission, bonus and use of car.—Please write, in first instance, giving brief details and confirming possession of essential qualifications, to Norgren Works, Shipston-on-Stour, Warwickshire. E6033 A

**PLANNING ENGINEER.**—A vacancy exists in a precision engineering company for a Planning Engineer between 23 and 30 years of age, who has a sound knowledge of general engineering workshop practice, possesses O.N.C. in Mechanical or Production Engineering and has preferably served an engineering apprenticeship. The responsibilities will include estimating and process planning applied to small batch production engineering. This is an attractive position offering considerable scope and excellent prospects with a basic salary of not less than £750 per annum. Profit-sharing and pension schemes are in operation and some assistance with housing will be given if required. Applications, stating age qualifications and full details of experience, should be sent to Personnel Officer, Universal Pattern Co., Kelvin Way, Crawley, Sussex. E1606 A

### POWER AND FUEL CONTROLLER

A new staff post is being created at a leading paper mill near Aberdeen. The mill, which produces most of its steam and electrical power requirements, has 14 oil-fired Lancashire boilers, 1 main steam turbine, 2 auxiliary steam turbines, 2 water turbines and a link up with the national grid.

The successful applicant, who should be under 50 years of age, will be responsible to the Chief Engineer for utilising this equipment efficiently and economically, and must have expert knowledge of steam boilers and high-power electrical plant, and be able to cost for these services. The position calls for a man with good personal qualities, particularly tact, who will be required to advise all departments on the best use of their power requirements.

No previous experience in the papermaking industry is necessary. The post is permanent and the company operates a good pension scheme. The salary will be attractive and will be subject to annual review. Assistance will be given in finding suitable accommodation.

Applications, in confidence, giving full details of qualifications and experience, should be sent to BOX No. E1605, "The Engineer." A

**PRODUCTION ENGINEER** required, with wide experience of reconditioning general plant. Only competent keen executive considered. House available, pension scheme. References required.—Fred Watkins (Engineering), Ltd., Coleford, Glos. E6059 A

**PROJECT ENGINEER** required by medium/heavy engineering company in Manchester district. Essential qualifications are a good Degree in Mechanical Engineering or equivalent, followed by substantial practical experience of engineering design and development. Knowledge of the rubber or plastics industries desirable, but not essential. This is a senior appointment to the Chief Engineer's staff of the company and salary will be commensurate with the responsibility of the position and the experience of the applicant.—BOX No. E1598, "The Engineer." A

**PROMINENT FIRM OF BUILDING AND CIVIL ENGINEERING CONTRACTORS** require young QUALIFIED MECHANICAL ENGINEERS or applicants who have completed indentured apprenticeships as Fitters and Turners, with Higher National Certificate, for posts in the plant organisation relating to inspection, overhaul and repairs to contractors' plant in the U.K. Excellent prospects of advancement providing those selected prove satisfactory after a probationary period, when entry to pension fund will be considered.—Applications, giving details of experience and qualifications, to BOX No. E6010, "The Engineer." A

**W. H. A. ROBERTSON AND CO., LTD.,** of Bedford, require EDUCATION OFFICER, to develop and operate Apprentice Training Scheme for Engineering and Trade Apprenticeships. Personality and an engineering background indispensable.—Applicants write to the Managing Director, Lynton Works, Bedford. E5063 A

**SENIOR DESIGNERS.**—Applications are invited from Senior Designers, experienced all in types of electric cranes, for important work in connection with steel works development schemes. Salaries will be commensurate with responsibilities, and only men of good structural and mechanical training are required.—Write, giving details of age, experience and salary required, to the General Manager, The Wellman Smith Owen Engineering Corporation, Ltd., Darlaston, South Staffs. E9949 A

**SENIOR DESIGN AND DEVELOPMENT ENGINEER** required, to lead small team of Engineers working on design and development of Liquid Fuel Combustion Equipment and Heat Exchangers for industrial use. Previous experience in one of these fields desirable but a good knowledge of fundamentals of Fluid Dynamics and Heat Transfer essential. A Degree or equivalent is necessary and candidates should be about 25–35 years of age.—Apply, Technical Manager, White's Marine Engineering Co., Ltd., Hebburn on Tyne. E5047 A

**SENIOR WORK STUDY ENGINEER** for work study department in expanding company manufacturing heavy electrical equipment in West London area. H.N.C. Mechanical and sound practical training essential. Write full details of career and salary required.—BOX No. E1599, "The Engineer." A

**HENRY SIMON (ENG. WKS.), LTD.**
MACHINE SHOP SUPERINTENDENT

The promotion within the Organisation of the present Machine Shop Superintendent creates a vacancy for the post in this general medium/heavy Engineering Works employing 1200 persons in North-West England. Salary not less than £1300, according to experience and qualifications. Pension scheme in operation. Applications should give full details of age, education, training and experience, and be sent to the
Personnel Director (Ref. QR.69),
Henry Simon (Eng. Wks.), Ltd.,
Cheadle Heath, Stockport, Cheshire. E6017 A

### SOILS ENGINEER

First-class opportunity for suitably qualified Civil Engineer to take leading position in new development with one of the principal U.K. building and civil engineering contractors operating both at home and overseas.

Good knowledge of theoretical soil mechanics and previous experience in site investigation methods and soils laboratory techniques and their application to the solution of constructional problems essential.

Generous salary and excellent prospects. Contributory pension scheme. London area.

Apply in writing, giving full particulars of training and previous experience, to BOX No. E6008, "The Engineer." A

**STRUCTURAL DETAILING DRAUGHTSMEN.**—Metal Constructions, Ltd., Brickfields Road, Worcester, require men experienced in all classes of steel-framed building, conveyor structures, hoppers, bunkers and constructional steelwork. Salary scale of £750/£850, excellent non-contributory pension and life insurance scheme, also assistance with housing.—Write, stating age, experience and full details, to this expanding company, which has a modern drawing-office in pleasant surroundings. E5986 A

**SUPERINTENDENT ENGINEER** required. Salary scale £980 by £30 (4) by £35 (1) to £1135 per annum. Post superannuable and there are good housing prospects. A form of application, with information of the duties, training and qualifications required, can be obtained from the Secretary and Treasurer, Board of Management for Coatbridge, Airdrie and District Hospitals, Hairmyres Hospital, East Kilbride. E6043 A

### THE BRITISH IRON AND STEEL RESEARCH ASSOCIATION

LEADERSHIP of Association's research in the Rolling of Metals will shortly fall vacant. The post offers opportunities of no mean order to a creative scientist or research engineer with experience in metals technology, applied mechanics, or control engineering. His activities will be centred on laboratories in Sheffield, but with industry-wide contacts. Starting salary up to £1350 p.a., according to age, qualifications and experience. Post is superannuated under the F.S.S.U.—Written applications only, quoting "M.W.4," to the Personnel Officer, B.I.S.R.A., 11, Park Lane, London, W.1. E6070 A

### THE SUPERHEATER COMPANY, LIMITED, POWER PLANT DIVISION 53, HAYMARKET, LONDON, S.W.1

require ENGINEERS having Degree or equivalent qualification for the Power Plant Division. The posts involve travelling to various power plant sites in the British Isles, but the successful applicants will be required to live in the London area. Previous experience in steam plant, though desirable, is not essential.—Applications are invited, in the first instance, to the Secretary at the above address, giving full details of age, qualifications and experience. E6024 A

**TECHNICAL SALES ENGINEER,** A.M.I. Mech.E., and/or B.Sc. Degree, is sought by leading company in Combustion and Heat Exchanger fields. The successful candidate will be required to operate from the Liverpool area and carry full responsibility for developing sales in this area. He must be a man with initiative, enthusiasm and his ability to negotiate at all levels will enable him to develop new markets. The preferred age range is 28–35. Apply.—BOX No. E9857, "The Engineer." A

**THE MIDLAND TAR DISTILLERS, LIMITED,** have a vacancy for an ENGINEER for work study and maintenance at their Four Ashes Refinery, near Wolverhampton. Preference will be given to applicants who have completed an apprenticeship training in engineering and educated to H.N.C. standard. The work involves chemical plant maintenance; experience of engineering maintenance of process equipment would be an advantage. Salary in accordance with experience and qualifications. The position has good prospects; permanent employment with good working conditions in a pleasant countryside can be offered to a suitable man. A contributory pensions scheme with life assurance is in operation. Assistance will be given in finding suitable accommodation and in meeting removal expenses, where necessary.—Apply, giving details of age, education, training and experience, to The Personnel Manager, The Midland Tar Distillers, Limited, Oldbury, Near Birmingham. E6053 A

### THE REED PAPER GROUP

have a vacancy for a

### PROJECT ENGINEER

in the Steam Department of the Group Engineering Division. This post is in an expanding department with much interesting development work in consequence. The successful candidate will be concerned with this development in connection with boiler, turbine, heating and ventilating plant and with steam services and feed water treatment. He will be required to design, prepare specifications and estimate for this work.

Age range 25–40. The possession of a Higher National Certificate is necessary and he must have completed an apprenticeship course, together with at least two years' drawing-office and two years' erection and installation experience. This is a permanent post and carries a good salary in a company where conditions of service are excellent and include non-contributory pension and house purchase schemes.

Applications, with full details of age and experience, should be sent to the Personnel Officer, Group Personnel Division, ALBERT E. REED AND CO., LTD., Larkfield, Nr. Maidstone, Kent, quoting ref. PE/9. E6068 A

### THE SUPERHEATER COMPANY, LIMITED, 53, HAYMARKET, LONDON, S.W.1

require SENIOR DRAUGHTSMEN and CHECKERS for their London office. Experience in steam boiler plant preferred, but not essential. Permanent and pensionable positions affording good prospects for suitable men. Applications are invited to the Secretary, giving full details of qualifications and experience. E6023 A

**TURNER BROTHERS ASBESTOS CO., LTD.,** ROCHDALE, LANCASHIRE, invite applications for a vacancy which has arisen in their TECHNICAL SALES DEPARTMENT. The successful applicant will have had a sound engineering training, along with some experience of allied sciences; he will be in the 30–37 age group and be prepared to travel extensively in the United Kingdom.—Applications, giving full particulars, should be made in writing and addressed to the Personnel Manager, endorsing envelope "Sales Technical." E6025 A

**TWO DESIGNER-DRAUGHTSMEN** are required for work on liquid fuel combustion equipment and heat exchangers for industrial use. Previous experience of this type of work is not essential, although an appreciation of fluid flow problems is necessary. Candidates should be of H.N.C. standard and should have a good knowledge of modern drawing-office procedure. Prospects of promotion are good.—Apply, Technical Manager, White's Marine Engineering Co., Limited, Hebburn on Tyne. E6026 A

## BRITISH TITAN PRODUCTS COMPANY LTD.

have vacancies for

## MECHANICAL ENGINEERS

**at their Technical Headquarters, Billingham, Co. Durham.**

The company is primarily concerned with the large-scale manufacture of Titanium Dioxide and is characterised by a ten-fold expansion in post-war years. This continuing expansion is associated with a large number of interesting mechanical engineering design problems in existing and proposed new plants and processes.

Applications are invited from Honours Degree Graduates in Mechanical Engineering or those with equivalent professional qualifications. Some industrial experience is preferred but fresh Graduates, including those who are at present engaged on National Service, and who will be available some time in 1958, may also apply. The age range envisaged is 25–35 years.

Salaries and prospects are very attractive for men with the right qualities: conditions of work are good: Staff Bonus, Superannuation Scheme and non-contributory Life Assurance are in operation: housing assistance is available if required. Applications will be treated in the strictest confidence and should be addressed to the Personnel Manager, British Titan Products Co., Ltd., Coppergate, York, quoting reference S. 32. E982 A

SITUATIONS VACANT

**MSL** have been retained to advise on the appointment of a

## PRODUCTION MANAGER

for an old established company with headquarters on the outskirts of Glasgow. The company designs and manufactures machinery for process industries.

The Production Manager will control two factories (labour force about 200), and will also be responsible for all production engineering and production control activities.

Candidates should be between 28 and 35, and hold a degree or professional qualification in engineering, and have served an apprenticeship. Experience of the production of complex mechanical equipment involving machining, press work, fabrication and some slight knowledge of foundry processes is desirable.

Prospects include a seat on the board in about five years.

Initial salary about £1,800. Pension. Removal assisted.

No information will be disclosed to our clients until candidates know their identity and have given permission after personal discussion. Please send brief details in confidence, quoting reference G.754, to T. E. Watson.

MANAGEMENT SELECTION LIMITED
17, Stratton Street, London, W.1.

E6005 A

---

SITUATIONS VACANT

The Atomic Power field offers considerable scope to

## HONOURS GRADUATES IN MECHANICAL ENGINEERING

who are capable of using their Degree to the fullest advantage. Some engineers may not realise that, although they have no experience of Atomic Power work, it is possible to obtain a position in this field at a salary level which would compete favourably with their existing salary. Such engineers are invited to write to us indicating their experience and present salary because we have found in many cases that such men can rapidly become key members of our team at Whetstone, Nr. Leicester, and can command excellent salary prospects.

Please write to Dept. C.P.S., Marconi House, 336/7, Strand, W.C.2, quoting reference ER 1817A.

## ENGLISH ELECTRIC
## ATOMIC POWER DIVISION

E5017 A

---

SHELL

## CIVIL ENGINEERS · PHYSICISTS

"Shell" Research Limited, have vacancies for suitably qualified Civil Engineers or Physicists, to take part in research on the mechanical properties of bituminous materials. In some cases the first year or two will be spent on an assignment at the Engineering Department of the University of Nottingham (where it may be possible to register for a higher degree) or on a training course elsewhere, to be followed by a permanent appointment at

**THORNTON RESEARCH CENTRE**
**(NEAR CHESTER)**

The work should be particularly attractive to a Civil Engineer with experience of road construction and a desire to do research, or to a Physicist with a strong practical bent.

Applicants should possess a good Honours Degree, and preferably be not more than 30 years of age. Excellent pension scheme. Facilities available for assistance with house purchase and reimbursement for cost of removal of established home.

Write to:

**"SHELL" RESEARCH LIMITED,**
STAFF DEPARTMENT (R/I), 16, FINSBURY CIRCUS, LONDON, E.C.2.

E6014 A

---

SITUATIONS VACANT

**MSL** have been retained to advise on the appointment of a

## PRODUCTION MANAGER

for a company in the London Area employing approximately 700 in the manufacture of foil packaging material.

The Production Manager will be responsible to the Works Manager for manufacture, quality of product and process improvements throughout the factory.

Candidates, who should possess a degree or other professional qualification in mechanical engineering, must have had experience of shop management, works study and modern methods of production control. A knowledge of the industry is an advantage, although not as essential as a flair for administration.

Age 30–35. Starting salary £1,500–£1,750 plus bonus with very good prospects of future promotion within the company.

No information will be disclosed to our clients until candidates know their identity and have given permission after personal discussion. Please send brief details in confidence, quoting reference G.760, to M. B. Berks.

MANAGEMENT SELECTION LIMITED
17, Stratton Street, London, W.1.

E6006 A

---

## IMPERIAL CHEMICAL INDUSTRIES, LIMITED,

**Billingham Division**
**and**
**Heavy Organic Chemicals Division**

**Careers for**

## MECHANICAL ENGINEERS

The new Heavy Organic Chemicals Division of Imperial Chemical Industries, Limited, was formed on 1st January, 1958, and certain of the works of the Billingham Division were taken over. This has meant an increase in the number of Mechanical Engineers required to fill the vacancies resulting from promotions and transfers and to undertake the expansion programme for both divisions.

A wide variety of engineering work is available, and the young engineer will have the opportunity to gain excellent all-round experience. There are immediate vacancies in design, research, work study and management. Post-graduate training on full salary can also be provided for graduates taking up a first appointment this year.

- ★ Attractive salary scheme. Profit-sharing, pension fund, subsidised canteens.
- ★ Assistance with house purchase and removal expenses for married men.
- ★ Substantial lodging allowance for married men for a period of up to six months.
- ★ Excellent social and games facilities.

If you hold a University Degree and are interested in the possibility of an appointment in either division, we invite you to write, giving brief details of age, qualifications and experience, to the Staff Manager, Imperial Chemical Industries, Limited, Heavy Organic Chemicals Division, Billingham, Co. Durham, quoting reference W/J/5.

E6049 A

---

## ENGINEERS

### MECHANICAL EQUIPMENT ENGINEERS

To undertake the selection of equipment such as pumps, compressors, turbines, refrigerating units, cooling towers and water treatment plant for Oil Refineries and Petro-Chemical Plants, reviewing suppliers' quotations for suitability of equipment offered and handling all engineering matters associated with the use of such equipment. Applicants must have University engineering degree. Experience in this field an advantage.

### INSTRUMENT ENGINEERS

For instrumentation of process units for Oil Refinery and Petro-Chemical Plants. B.Sc. desirable.

We provide good working conditions and excellent personnel benefits and the opportunity to improve your engineering knowledge, with ample scope for advancement. If you possess experience applicable to either of these categories please write to the Personnel Manager.

KELLOGG INTERNATIONAL CORPORATION

**7-10 CHANDOS STREET LONDON, W.1.,** *or 'phone MUS.4010 quoting reference 121/G.*

E6042

---

## A DIESEL DEVELOPMENT ENGINEER

is required by English Electric, Rugby.

Applicants should hold an Honours Degree and be capable of planning systematic and comprehensive engine tests, making effective analysis of results obtained, and interpretation of trends.

Research experience is desirable. This post has great potentialities for the right man, as he will be responsible for future programmes based on his findings on earlier tests.

Write giving full particulars to Dept. C.P.S., 336/7, Strand, W.C.2., quoting Ref. ER 1104F.

E6037 A

Classified Advts. continued on page 144

SITUATIONS VACANT

*Research Careers near Birmingham.*

## Opportunities with Wilmot Breeden Laboratories

As part of a planned expansion of the Research and Development Division, there are now vacancies in the Wilmot Breeden Laboratories for :

(*a*) **Graduate Research Engineers, Physicists and Mathematicians** interested in fundamental and applied studies of mechanisms. (Experience not essential.)

(*b*) **Graduate Physical and Organic Chemists,** to work on fundamental problems in electrochemistry and metal finishing. (Experience not essential.)

(*c*) **Senior Designers** interested in the evolution and development of mechanisms.

The Laboratories are in a pleasantly situated country house between Birmingham and Stratford. Working conditions ideal. Transport provided. Attractive salaries and superannuation scheme. Applications in confidence to :

**Research Director,**
**Wilmot Breeden Laboratories,**
**Umberslade Park,**
**Hockley Heath, Solihull,**
**Warwickshire.**

E6038 A

SITUATIONS VACANT

**MSL** have been retained to advise on the appointment of a

### TECHNICAL SALES MANAGER

for a company in South Wales employing approximately 450 on heavy engineering and steel fabrication. The company is one of a group and has a progressive policy of expansion for which additional factory space is under construction.

The Sales Manager is responsible direct to the General Manager (Director) for all aspects of marketing the company's products.

Candidates must have the necessary technical knowledge, but selling experience is the first essential. Sales to the oil, steel, and chemical industries and the nationalised industries are of prime consideration.

Preferred age 35–45. Salary £1,500–£2,000. Excellent opportunities for further advancement.

No information will be disclosed to our clients until candidates know their identity and have given permission after personal discussion. Please send brief details in confidence, quoting reference G.753, to T. E. Watson.

**MANAGEMENT SELECTION LIMITED**
**17, Stratton Street, London, W.1.**

E6007 A

SITUATIONS VACANT

## ENGINEERING DEVELOPMENT

ENGINEERS of high calibre are needed by the National Coal Board at their newly built Central Engineering Establishment at Stanhope Bretby, near Burton-on-Trent.

They will develop and test all forms of machinery and equipment for cutting, loading and transporting coal, for driving underground roadways, for strata control, and for coal preparation—in short, for all the varied engineering activities associated with modern techniques of mining coal. Such work is done either at the Establishment or by outside manufacturers working to its requirements.

There are excellent design facilities, workshops and laboratories ; also a proving ground for full-scale trials. Projects are handled by balanced teams, which include Design Engineers, Mechanical Engineers (including structural and hydraulic specialists) and Electrical Engineers (including control and instrumentation specialists.

The vacancies are for :

(i) PROJECT ENGINEERS, for the technical investigation and specification of projects, and their co-ordination and control.
(ii) DEVELOPMENT ENGINEERS, for designing machines and special equipments to satisfy users' specifications.
(iii) PROVING ENGINEERS, for testing machines and materials at laboratory, proving ground and underground stages of development.
(iv) SPECIAL PROJECT ENGINEERS, for developing coal preparation plant and services allied to chemical engineering.

Salaries will depend on the ability and experience of candidates, and the responsibilities of the different vacancies : some will range above £2000 p.a.; others, in lower ranges, should prove attractive to well-qualified younger engineers, for whom existing conditions and future prospects are excellent.

Engineers interested in this type of creative work are invited to write or telephone for application forms to National Coal Board, Staff Dept. (X1057G), Hobart House, London, S.W.1 ('phone, SLO 3401, Ext. 543), indicating work preferred. The forms should be returned by 24th February, 1958.

E6040 A

## DESIGNER-DRAUGHTSMEN

**INSTRUMENT**
**ELECTRICAL**
**PRESSURE VESSELS**
**& HEAT EXCHANGERS**

Designer-Draughtsmen in these categories are cordially invited to contact KELLOGG INTERNATIONAL CORPORATION, leading Design and Construction Engineers of world-wide repute in the petroleum and chemical industries. We provide good working conditions and excellent personnel benefits with opportunities for advancement, and have immediate vacancies in our new additional premises. Please write to the Personnel Manager,

KELLOGG INTERNATIONAL CORPORATION
7-10 CHANDOS STREET, LONDON, W.1 *or telephone MUS 4010 quoting reference 120/G*

E5041

## MICHELIN TYRE CO. LTD.,

- **Stoke-on-Trent**
- **have progressive openings for**
- **DESIGNER/DRAUGHTSMEN**

(*a*) With H.N.C. and preferably Thermo-dynamics endorsement, for interesting work in connection with Works Services—boiler plant, steam and hydraulic applications, pipework.

(*b*) With H.N.C. (mechanical) and experience design of medium to heavy process plant. Some knowledge belt and chain conveyors desirable.

(*c*) With H.N.C. (electrical) or O.N.C., and now studying for H.N.C. for work on motor applications, lighting schemes and general factory electrical services.

Good commencing salaries, related to qualifications and experience, are offered, plus a contributory pension scheme, free life assurance and excellent welfare facilities.

**Assistance with housing will be given if required.**

*Please write in confidence to :—(Mr.) J. E. Glendenning, c/o above, quoting reference B2/E.*

E9916 A

SIR ROBERT McALPINE & SONS LTD.,
as a member firm of
THE NUCLEAR POWER PLANT CO. LTD.,
require

## CIVIL ENGINEERING DESIGNERS
and
## REINFORCED CONCRETE DRAUGHTSMEN

The work consists of heavy civil engineering design of a large variety of structures for contracts, both at home and abroad. Wide range of salaries according to qualifications. Five-day week, canteen, social club. The office is situated in pleasant surroundings at KNUTSFORD, Cheshire.

Written application, with an accompanying sheet giving full details of age, education, qualifications and salary expected, should be sent to :

A. Houghton Brown,
Booths Hall,
Knutsford,
Cheshire.

E5098 A

WILTON ICI WORKS

## MIDDLESBROUGH

has vacancies for

## MECHANICAL ENGINEERS

Britain's largest chemical project, Wilton Works, is on a 2000-acre site, near the Cleveland Hills. Development consists of building plants, including a complete Power Station, which embody the most up-to-date designs of building, civil engineering and mechanical engineering.

The number of Mechanical Engineers required for design, construction, operation and Work Study is steadily increasing as the Works continue to grow.

Salaries depend on ability and experience and are reviewed annually. Promotion is by merit alone and individuals are considered at regular intervals. Help will be given with housing and removing, and a lodging allowance will be paid for a period to married men selected for these appointments, whilst maintaining two homes.

Suitable applicants, who should possess an Honours Degree, will be invited for interview at the Company's expense.

Please write to the Staff Manager, Imperial Chemical Industries, Limited, Wilton Works, Middlesbrough, Yorkshire, quoting Advertisement reference 458/4.

E6048 A

## SITUATIONS VACANT

**British Oxygen Engineering Limited**

### ASSISTANT TO THE CIVIL CONSTRUCTION MANAGER

Applications are invited from young Civil Engineers for the post of Personal Assistant to the Civil Construction Manager.

A Degree or equivalent qualification is required coupled with a minimum of two years' experience of the Design or Construction of civil engineering and building work.

An excellent salary and conditions of service are offered and **assistance with HOUSING can also be arranged.**

*Apply in writing to:*

THE STAFF OFFICER,

**BRITISH OXYGEN ENGINEERING LIMITED,**

**Angel Road, Edmonton, London, N.18.**

*Telephone: EDM. 3020*

E6045 A

## SITUATIONS WANTED

**ASSISTANT ENGINEER,** with a view to eventually becoming Chief Engineer and Designer of large mechanical engineering firm. B.Sc. Lond., First Hons., 6 years std. apprenticeship Babcock and Wilcox, &c.—Available April.—Forbes-Gower, 16, Salisbury Road, Barnet. E1610 B

**CHARTERED MECHANICAL ENGINEER,** at present time Deputy Works Engineer to large chemical manufacturers, seeks change. Would consider going abroad.—BOX No. E1600, "The Engineer." B

**CIVIL ENGINEER,** B.Sc. (Hons.), age 46, after ten years in charge of various large construction projects in Middle East, including earthworks, reinforced concrete, welded steelwork and harbour works, desires post, preferably for some time in U.K.—BOX No. E1612, "The Engineer." B

**GENERAL MANAGER.**—A.M.I.Mech.E., A.M.I.P.E. (40), experience production automobiles, aero engines and general engineering. Some iron foundry experience, also commercial. Excellent record labour relations. Present salary £3000, but change to where experience on precision work can be fully utilised more important.—BOX No. E1519, "The Engineer." B

**INTEGRATED DATA-PROCESSING.** — Electrical engineering graduate, broad training in heavy electrical industry (27), wishes to make career where enthusiastic long-term thinking on O. and M., O.R., programming lead to Integrated Data-Handling Systems for Industry. South-East England preferred. —BOX No. E1613, "The Engineer." B

**STOREKEEPER (37)** desires position as Sales Correspondent or Representative. Seven years storekeeping, ex-officer, some French and Hindustani, clean driving licence.—BOX No. E1609, "The Engineer." B

## FOR HIRE

**LATTICE STEEL** Erection Masts (light and heavy), 30ft. to 150ft. high, for immediate hire.—Bellman's, 21, Hobart House, Grosvenor Place, S.W.1 ('Phone, SLOane 5259). E112 K

## BUSINESS OPPORTUNITIES

**CAPACITY AVAILABLE** for any suitable product on basis of licence agreement, royalty, or sub-contract. Reputable firm structural engineers, with extensive welding equipment and mass production facilities. Flexible outlook and full co-operation. Brief details in strict confidence.—BOX No. E1551, "The Engineer." O

## BUSINESSES and PREMISES

**WILSON STREET, E.C.2.** New Commercial and Industrial Building. Area about 20,000 sq. ft. on Ground, Basement and Four Upper Floors. Two main entrances, loading dock, passenger/goods lift, central heating; floor loading 200 lb. per sq. ft. Rent £9000 p.a. exclusive; lease 21 years. Immediate possession.—Sole Agents, Chamberlain and Willows, 23, Moorgate, E.C.2 (MET 8001). E9912 L

**HIGH HOLBORN.**—Commercial Building, 2400 sq. ft., 21 years' lease. Central heating. £1500 p.a.—Chamberlain and Willows, 23, Moorgate, E.C.2 (MET 8001). E6003 L

**CHRISTCHURCH, HANTS**
(Fronting Main Line)

INDUSTRIAL SITE of 1¼ acres, together with buildings containing about 10,000 sq. ft. Manager's House.

Further particulars of:

LEOPOLD FARMER AND SONS,
Industrial Property and Plant Specialists,
46, Gresham Street, London, E.C.2.
Telephone: MONarch 3422 (8 lines).
E6015 L

## MISCELLANEOUS

**ADVERTISER** wishes to get in touch with engineer familiar with flying bomb engines.—BOX No. E1592, "The Engineer."

## AGENCIES

**MANUFACTURERS** seeking to increase their sales in Scotland may secure reliable agents by writing with particulars to the Secretaries of the Scottish Association of Manufacturers' Agents who will advertise under a box number, in the Association News Letter.—Write to Dept. E., Hourston MacFarlane and Co., 5, St. Vincent Place, Glasgow, C.1. E962 D

## SUB-CONTRACTING

**ACCURATE MACHINING**
also on Models and Prototypes, &c.
MILLING TURNING
JIG BORING PLANING
PRESS TOOLS, JIGS AND FIXTURES
HORIZONTAL BORING
GIVE US YOUR DIFFICULT JOBS
LANDEN (ENGINEERS), LTD.
1A, AUBERT PARK, LONDON, N.5.
CANonbury 1075 E871 MW

**CASTINGS.**—We can save your porous castings, ferrous or non-ferrous, by an approved impregnation process; sample castings treated; A.I.D. approved. —Recupero, Ltd., 66, South Harrow Viaduct, Harrow, Middlesex ('Phone, Byron 1178). E575 MW

**CASTINGS** in Meehanite Process Cast Iron can be undertaken by a well-known engine company in the Manchester Area, who have Spare Capacity due to improved efficiency.

Castings large or small. Castings in Brass or Aluminium can also be supplied.

Inquiries to BOX No. E1542, "The Engineer." MW

**DRAWING-OFFICE CAPACITY AVAILABLE** for the design and/or detailing of material handling and structural contracts. Enquiries welcomed and promptly dealt with.

C. G. BARKER, LTD.,
60, Lowfield Street,
Dartford, Kent.
(Tel.: Dartford 2626). E1604 MW

**KELLERING** and Profile Milling in all metals. Send us your die blocks to copy from wood or plaster masters. Up to 5ft. by 8ft. max. size. We are die copiers to the trade.—ARMYTAGE BROS. (KNOTTINGLEY), Ltd., The Foundry, Knottingley Yorkshire (Tel.: Knottingley 2743/4). E948 MW

**PRATCHITT BROTHERS, LTD.,** Denton Iron Works, Carlisle, having well-equipped engineering shops and ironfoundry, invite inquiries for general Engineering, Structural and Plate Work from firms wishing to have plant made to their own designs and specifications. E720 MW

**PRECISION ENGINEERS.**—Personal service for prototypes, small quantity machined parts and equipments. Design and development undertaken. A.I.D. Approved.—Bowyer, Smyth and Partners, Ltd., Vineyard Walk, Clerkenwell, E.C.1 ('Phone, TERminus 5113/4). E650 MW

**SPARE CAPACITY.**—Engineers, Manchester area, have spare Capacity for producing Iron Castings, Machined Iron Castings, Assembly Work, Fabricated Steelwork, &c.—BOX No. E6011, "The Engineer." MW

The Specialist Foundry
for
**BLACKHEART MALLEABLE IRON CASTINGS**
●
**HEAT AND ABRASION RESISTING ALLOY CASTINGS**
●
*Manufacturers of the*
**'PULMAC' PULVERISING MILLS**

**FOLLSAIN-WYCLIFFE FOUNDRIES LTD.**
**LUTTERWORTH, Nr. RUGBY**
**Tel. 10, 60 & 152** E985 MW

## MACHINERY Etc. WANTED

**WANTED,** Machines of all Types.
CASH PAID.
Norman E. Potts (B'ham), Ltd., 130, Moseley Road, Birmingham, 12. VIC. 1278, 1279, 1270, 0856. E123 F

**WANTED** to purchase, a 10/15-ton Electric Derrick Crane, with 120ft. jib. Butters preferred.—BOX No. E6013, "The Engineer." F

## FOR SALE

**ONE 4-COLUMN UPSTROKE PRESS,** main ram 18in. dia., strokes 15in., maximum daylight 24¼in., working daylight 19¼in., columns 5¼in. dia., column centres 2ft. 4in. by 1ft. 11in. Complete with Towler pumps and control valves, oil tanks, &c., with 10 h.p., 420 volt, 3 phase motor and switchgear. Pressures 1400 lb. sq. in. and 150 lb. sq. in. Ram speeds, approach 13 inches/min. at 150 lb. sq. in.; pressing 10 inches/min. at 1400 lb. sq. in. May be inspected by appointment, London area.—BOX 672, c/o Walter Judd, Ltd., 47, Gresham Street, E.C.2. E9957 G

## FOR SALE

**FRED WATKINS (BOILERS), LTD.**

STEAM BOILERS.—Cochran Vertical (New), 8ft. 6in., 8ft., 7ft. 6in., 7ft. and 6ft. in dia., 100/150 lb. w.p.; reconditioned 8ft. 6in. down to 3ft. dia.; Economic, 4ft. to 11ft. 6in. dia., including new 7ft. and 8ft. dia., 150, 180 and 200 lb. w.p.; 300 reconditioned Vertical Crosstube, all sizes.

AIR COMPRESSORS.—Broomwade 510 cu. ft.; Tilghman 365 cu. ft.; Broomwade 300, 200 and 130 cu. ft.; all motorised.

200 AIR RECEIVERS, stocked up to 9ft. dia., 100 to 500 lb pressure.

ELECTRIC MOTORS.—150 Totally Enclosed and Flameproof Motors up to 100 h.p.

CRANES.—Mobile 10-ton Lorain, lorry mounted, 30ft.–70ft. extendable jib; 8½-ton Ransomes Diesel-Electric, 1948; 4-ton Coles Diesel-Electric; 3-ton Jones Super 40 (3); Neals 2-ton Diesel, 20ft. jibs (2); Derrick, 5-ton Butters Electric travelling type, 90ft. jib; 5-ton Wilson Electric, 70ft. jib; 3-ton Rushworth Electric, 65ft. jib; Steam Loco., 18-ton Brownhoist, 50ft. jib; 10-ton Coles, 40ft. jib; 8-ton Wilson, 35ft. jib; 5-ton Smith, 50ft. jib; 5-ton Cowans Sheldon, 50ft. jib; 5-ton Grafton, 38ft. jib; E.O.T., 10-ton Vaughan, unused, 40–60ft. span; 5-ton Henderson, 24ft. 7¼in. span, 1946; 5-ton King, 29ft. 3in. span; 2-ton Morris, 18ft. span; 2-ton Smith, 34ft. span.

RAILWAY MATERIAL.—Ruston 80/88 h.p. Diesel Loco., electric start, flameproof; Peckett 14in. by 22in. and 7in. by 12in. Steam Locos.; 3 miles 20 lb. Track, 24in. gauge bogies, turnouts, locos., &c.

STEEL PIPING.—50,000ft., 2in. Galvanised new 60,000ft., black new; 5000ft., 8in. seamless; 1000ft., 12in. seamless; 500ft., 14in. seamless; 400ft., 18in. riveted; 280ft., 21in. o.d. welded flanged; 3800ft., 21in. seamless flanged; 500ft., 24in. riveted; 1450ft., 27in. o.d. welded flanged; 216ft., 48in. riveted; 216ft., 60in. riveted.

CAST IRON PIPES.—Large stocks all sizes up to 24in. flanged and s.s. Immediate delivery.

VALVES.—Exceptional Surplus Ministry Lot New Stainless Acid Cocks and Valves, over 5000, immediate delivery, below makers' prices. Large stock, all sizes, Parallel Slide Sluice, Gunmetal, Reducing and Check Valves. List on request.

STORAGE TANKS.—300 cylindrical and rectangular up to 12,000 gallons, for oil and petrol, also sectional steel and cast iron up to 50,000 gallons.

MACHINE TOOLS.—Scriven Plate Bending Rolls, 14ft. by ¾in.; Robertson Straightening Rolls, 8ft. 6in. by ¾in.; Berry Bending Rolls, 7ft. by ¾in.; Tangye 300-ton Hydraulic Horizontal Straightening Press, 15ft. by 3ft. table; Herbert 3ND Miller, 61in. by 15in. table; Pels Punch and Shears, ¾in. capacity; nine new 2 cwt. and 1 cwt. Pneumatic Hammers.

SLING ENGINEERING WORKS,
COLEFORD, GLOS.
'Phone: Coleford 2271/2. E366 G

**600**
**SPECIAL OFFER**

NEW 20,000 c.f.m., 100 p.s.i.g., Electrically-driven TURBO-COMPRESSOR SET by DANIEL ADAMSON, driven through Davey Brown reduction gearbox by Met.-Vick. motor, 4145 b.h.p., 1500 r.p.m., 6600/6300/3/50, with control gear.

AVAILABLE AT REDUCED PRICE.

GEORGE COHEN,
SONS AND CO. LTD.
WOOD LANE, LONDON, W.12.
Tel.: Shepherds Bush 2070; and
STANNINGLEY, Nr. LEEDS.
Tel.: Pudsey 2241. E200 G

**MULTIMAT No. 3 CENTRELESS GRINDER:**

Capacity ¼in. to 7¼in. diameter grinding wheel 24in. by 12in.; control wheel 14in. by 12in. hydraulic wheel dresser; motor 37 h.p.

F. J. EDWARDS, LTD.
359–369, EUSTON ROAD, LONDON, N.W.1.
EUSton 4681. E5061 G

**HYDRAULIC PRESSES**

Large stock of modern Presses up to 10,000 tons capacity, for Forging, Forming, Extruding, Baling and other duties.

Enquiries from the Specialists:—
REED BROTHERS (ENGINEERING), LTD.,
Replant Works, Woolwich Industrial Estate,
London, S.E.18.
Tel.: Woolwich 7611 (6 lines).
E6029 G

**ALFORD DRAINAGE BOARD**
**DISPOSAL OF EXCAVATORS**

The Alford Drainage Board has for DISPOSAL the following EXCAVATORS with dragline equipment:—
(a) 1947 Priestman "Cub" Excavator.
(b) 1949 Priestman "Wolf" Excavator.
For further particulars apply to The Engineer to the Board, Station Road, Sutton on Sea, Lincs. E6034 G

**VIRTUALLY NEW** 15-ton Electric Derrick Crane, 120ft. jib, two-motor type, 500-volt D.C. Can be converted to A.C. supply at cost.
Vales Plant Register, Limited, 14, Lower Grosvenor Place, London, S.W.1. E484 G

## FOR SALE

**SOAG**
**HIGH CLASS**
**GEARMAKING MACHINES**
**IN STOCK**

**GEAR SHAPER**
**(FELLOWS TYPE)**

LORENZ Model SV00 (Fellows type), motor drive, for internal and external spur and helical gears; external gears: max. spur dia. 7¼in., max. helical dia. 6¼in., max. face width 2in.; internal gears: max. spur dia. 5¼in., max. helical dia. 5¼in., max. face width 1 3/16in.; max. D.P. for spur gears in steel 6·35; 6 speeds 164–535 strokes per min.

FELLOWS No. 71, motor drive, for external and internal spur gears only; max. ext./int. pitch dia. 7in./5¼in., max. ext. face width 1¼in., max. int. face width ¼in./1in.; max. ext. D.P. 6, max. int. D.P. 6/8; max. cutter dia. 3in.

DRUMMOND "MAXICUT" No. 3, for internal and external spur gears only; max. int. and ext. pitch diameter 18in., max. ext. face width 5in., max. int. face width 3in.; max. spur D.P. 3/4; 8 speeds 50–300 strokes per min.

**GEAR GENERATOR**

RAPIDAN Heavy Duty Gear Generator, Size No. 4 extended, motor drive, for internal and external spur gears; capacity: internal gears 68in. dia., external gears 56in. dia., face width 1in.–6in. max.; max. D.P. 2.

**GEAR HOBBERS**
**(PFAUTER TYPE, &c.)**
**HOBBERS**

PFAUTER R2, motor drive through 6-speed gearbox, with differential, max. gear dia. 39½in., max. face width 11¼in.; max. D.P. 2½.

GOULD and EBERHARDT Model 8H Gear Hobber, motor drive, for spurs, splines, sprockets and worm wheels, max. dia. 6in., table dia. 10in., face capacity spur gears 12in.; 4 D.P.; 10 hob speeds 48–200 r.p.m.

PFAUTER R9 Horizontal, motor drive, for small dia. spur gears with coarse teeth, heavy splined shafts and worms; height of centres 5 5/16in., max. dia. hobbed 10¼in., max. hobbing length 19½in., max. D.P. 2; min./max. number of teeth hobbed 4/100; 6 hob speeds 44–127 r.p.m.

MUIR Model M.T.9 Heavy Duty Large Capacity Hobber, for spur, spiral and helical gears and worm wheels; max. dia. of spur gears and worm wheels 90in.; max. dia. of spur gears running at high speeds 72in., max. spiral dia. with max. width at 10 deg. angle 90in., max. spiral dia. with max. width at 45 deg. angle 70in., max. spur and helical width 26in.–30in., according to dia., max. D.P. 1½, table dia. 58in., range of hog speeds 18–80 r.p.m.; h.p. main motor 12.

**GEAR PLANERS**

SUNDERLAND 6A, motor drive, for spur gears only, max. dia. 24in., max. face width 8in., max. D.P. 3, max. distance spindle and to outer support 14in.

BILGRAM 6in. Straight Bevel Gear Planer, motor drive, single tool type, max. pitch dia. 7¼in. (ratio 1:2), range of pitch angular adjustments 9 deg. to 85 deg., largest apex distance 7¼in., longest face 3in., coarsest pitch 3½ D.P.

Inspection invited.

Send us your inquiries.

SOAG MACHINE TOOLS LTD.,
JUXON STREET, LAMBETH, LONDON, S.E.11.
'Phone: RELiance 7201.
'Grams: Sotoolsag, London, S.E.11.
E211 G

**TWW**

STANLEY 7in. CENTRES S.S. and S.C. GAP BED LATHE, admits 3ft. between centres, all-geared head, spindle capacity 20–360 r.p.m., with Norton gearbox, self-contained motor drive for 400/440/3/50 cycles supply.

TWO OMA SL.800 GEAR SHAPING MACHINES, maximum diameter of external gears with 4in. cutter, 8in.; width 1 9/16in. cutter, 10¼in.; maximum height external and internal gears 2in., self-contained motor drive for 340 volts, 3-phase, 50 cycles, with guides for helical and straight gears.

MAIDEN 6in. TUBE SCREWING MACHINE, with radial diehead and electrical equipment for 400/440/3/50 cycles supply.

FOUR ORMEROD 12in. STROKE SLOTTING MACHINES, maximum diameter admitted 4ft., maximum height 1ft. 6in., 2ft. 3in. diameter table, with new 10 h.p. motor and starter for 400/440/3/50 cycles supply.

THOS. W. WARD LTD.
ALBION WORKS - - - SHEFFIELD.
'Phone: 26311. 'Grams: "Forward."
E213 G

**METROPOLITAN-VICKERS 500 H.P. SLIP-RING ELECTRIC MOTOR,** 196 r.p.m., 400/440/3/50 cycles, complete with control panel and reduction gearbox, giving a final speed of 8·1 r.p.m.

Motor and gearbox available separately if required.

JOHN CASHMORE, LTD.,
Newport, Mon.
Tel.: Newport 66941 (6 lines).
E991 G

**TWO RYDER 5-SLIDE FORGING HAMMERS** for Sale. Capacity: round and square bars up to 1¼in., tubes up to 3in. diameter. Weight about 36 cwt. each. Photos. available.—F. J. Edwards, Limited, 41, Water Street, Birmingham, 3 (Central 7606). E6063 G

**Classified Advts. continued on page 146**

## FOR SALE

**Edwards**

WESTON Model 400/100 Double-Sided, Friction Screw Press of steel plate construction ; pressure about 120 tons, maximum stroke 11in., diameter of screw 6½in., maximum daylight, ram up, 11in., bed 21 9/16in. by 18in., arranged motor drive 380/420/3/50. Weight about 5 tons.

NEW STOELTING Pyramid Type Plate Bending Roller, motorised 400/440/3/50, capacity 10ft. wide by ½in. mild steel, diameter of rollers, top 9½in., bottom 7⅜in., drop end bearing for removal of completed cylinders, support rollers to bottom rolls, reduction gearbox drive to bottom rolls with multi-disc slipping clutches, motorised adjustment to top roller.

SEDGWICK Power Plate Bending and Folding Machine, with swing-out end frame, arranged motor drive for 400/3/50, capacity 6ft. by ¼in. on full length or 2ft. 8in. by 3/16in. on short length, at present fitted with 17 segmental top blades 4in. wide by 5½in. deep.

Motorised Worm Geared Precision Guillotine, undercrank type, capacity 8ft. wide by ¼in. thick mild steel, gap in open ends 6½in., arranged motor drive 400/440/3/50, cam-operated automatic hold-down and all gauges. Weight about 6½ tons.

NEW BRAUCHLI Model AS2050×8 All-Steel Motorised Hydraulic Guillotine, open-ended type, with tilting table enabling bevel cuts to be made from 0 deg. to 30 deg., capacity 6ft. 6½in. by 5/16in. thick, drive to hydraulic pump from electric motor for 400/3/50, all gauges.

JOHN HANDS Style SCG No. 8 Double-Geared, Double-Sided Press, with cast steel body, pressure exerted about 400 tons, stroke 8in., between uprights 26in., bed 24in. by 26in., arranged motor drive. Weight about 10 tons.

Photographs of the above are available.

MACHINE TOOLS, NEW AND USED,
Of Every Description. Attractive Prices.

**F. J. EDWARDS, LTD.,**
359–361, EUSTON ROAD,
LONDON, N.W.1.
Telephone : EUSton 4681–3771.
And at
LANSDOWNE HOUSE, 41, WATER STREET,
BIRMINGHAM, 3.
Telephone : Central 7606–8. E209 G

---

**LIFTING MAGNETS** by Igranic for sale, designed to lift 45,000 lb. of steel coils, 72in. dia. by 24in. bore, powered by 440V. d.c.—BOX No. E5037, "The Engineer." G

**PIPES, 7IN. BORE, CAST IRON STANTON,** in new condition, complete with coupling rings, 440 lengths 12ft. at £23 ton for substantial lots.—Inspection.—TODD BROS. (St. Helens and Widnes), Ltd., Second-hand Dept., Sutton Oak, St. Helens. 'Phone : St. Helens 7358. E5048 G

## FOR SALE

**SURPLUS STOCK**

We have for disposal a large quantity of AIRCRAFT STANDARD PARTS, including Nuts, Bolts, Screws, Rivets, Pins, &c., also quantities of SMALL TOOLS, including Taper Pin Reamers, Taps, Router Cutters and End Mills, &c., 30 gross of 5/32in. N.P.K. LOCATING SCREWS.
Why not send for full list to :
General Salvage Officer,
Hunting Aircraft, Limited,
The Airport,
Luton, Beds. E1611 G

---

## FOR SALE

9 cu. yd. Foden Diesel Dumper, reconditioned Gardner diesel engine, fitted with double reduction clutch.
1 cu. yd. Chaseside Loadmaster "500" Diesel-driven Loading Shovel. New May, 1957.
1 cu. yd. Rapier 440 Diesel-driven Excavator, with face shovel or dragline equipment.
5-ton Morris Versatile Diesel/Elec. Mobile Crane on solid rubber tyres.
6-ton Rapier Super and Standard Pet./Elec. Mobile Cranes on solid rubber tyres.

**WILLIAM G. SEARCH, LIMITED.**
WHITEHALL ROAD, LEEDS, 12.
Tel.: 639081 (10 lines).
SEARCH (LIVERPOOL), LIMITED,
HAMMOND ROAD,
KIRKBY TRADING ESTATE, LIVERPOOL.
Tel.: Simonswood 2634–5–6.
E5027 G

---

**WARD 2A, 3A AND NO. 7 CAPSTAN LATHES,** also Ward No. 7 and 8 COMBINATION TURRET LATHES, available ex stock. Several reconditioned.—Quotations from H. BELL (MACHINE TOOLS), LTD., Walter Street, Leeds, 4 (Tel.: 63–7398). E185 G

---

**10-TON MORRIS,** 3-motor, cabin-controlled, twin-girder Overhead Electric Travelling Crane, 47ft. 6in. span, 20ft. lift, 460/500 V. D.C.
10-ton brand new Morris Crab, with totally enclosed gearing to suit above crane.
F. BURRILL AND CO.,
235a, Cathedral Road,
Cardiff (Tel.: 26100.) E6057 G

---

**NISSEN TYPE HUTS** for sale. Prompt despatch of 16ft., 24ft. and 30ft. wide huts ; also "Romney" Huts, 35ft. wide, and "Blister" Hangars, 86ft. 6in. and 91ft. wide. These buildings are in various lengths and comprise steel framework with galvanised corrugated steel sheeting.—Full details from Dept. 115, J. Thorn and Sons, Ltd., Brampton Road, Bexleyheath, Kent (Tel., Bexleyheath 305). E681 G

## FOR SALE

**ST. FRANCIS HOSPITAL**
**HAYWARDS HEATH, SUSSEX**

Three Ruston and Hornsby type V.E. OIL ENGINES for sale. Each direct coupled to Crompton-Parkinson 50kW, 240/300-volt, 208/167 amp., 300 r.p.m., shunt-wound D.C. generators. Date of manufacture 1926. Complete with auxiliaries, comprising three circuit breaker panels, battery charging motor generator and panel, starting air receivers, air compressors and circulating pump.

The plant can be inspected upon application to the Superintendent Engineer.

Offers in writing to be received by the Group Secretary not later than 28th February, 1958. E6031 G

---

**NEW COLCHESTER "MASCOT"** S.S. and S.C. Gap Bed LATHE. 8½in. H.C. by 54in. B.C. Price £898. Delivery immediately ex our London stock.—Welling and Welling, Ltd., 4, Victoria Street, London, S.W.1 (Tel.: ABBey 2341). E989 G

---

**FOR SALE,** complete modern high-class Steam Turbine Plant, 5000kW. capacity, 5000/5500 volts, three-phase, 50 cycles, 600 p.s.i., 870 deg. F., with two boilers 37,000/46,000 lb. per hour, 750 p.s.i., with control and distribution equipment, and two 3500kVA. transformers. Low price for quick sale.—BOX No. E5092, "The Engineer." G

---

**C·E·M**

"BENTLEY" Plate Bending Rolls from 6ft. by ¼in. up to 10ft. by 1in. m.s. capacities. Opening end frame for withdrawing rolled cylinders, self-supporting top roll, finger-tip control, all rolls of generous dia. from solid forged steel, full electrical equipment. Very moderate prices. Early deliveries.

"SEDGWICK" Universal Plate Bending and Folding Machine, 6ft. by ¼in.

"EDWARDS" Undercrank Guillotine, 8ft. by ¼in.

"PEARSON" Electro Hydrolic Guillotine, 8ft. by ½in., for early delivery.

Fully detailed stock lists available on request.

**CHARLES E. MATTHEWS (Machine Tools) LIMITED,**
**Gladstone Road, CROYDON.**
Tel. No.: Thornton Heath 1783.
Telegrams : "Matolco," Croydon.
E994 G

## FOR SALE

THE 600 GROUP OF COMPANIES

**RECONDITIONED**
**JONES CRANES**
**with 3 Months' Guarantee**

| | | |
|---|---|---|
| KL.44 | Capacity | 4 tons |
| KL.40 | ,, | 3 tons |
| KL.22 | ,, | 2 tons |
| KL.15 | ,, | 15 cwts |

*All Jones Cranes receive 12 months' free after-sales service when supplied by:—*

**GEORGE COHEN**
**Sons and Company Limited**
**WOOD LANE, LONDON, W.12**
Telephone : SHEPHERDS BUSH 2070
E9859 G

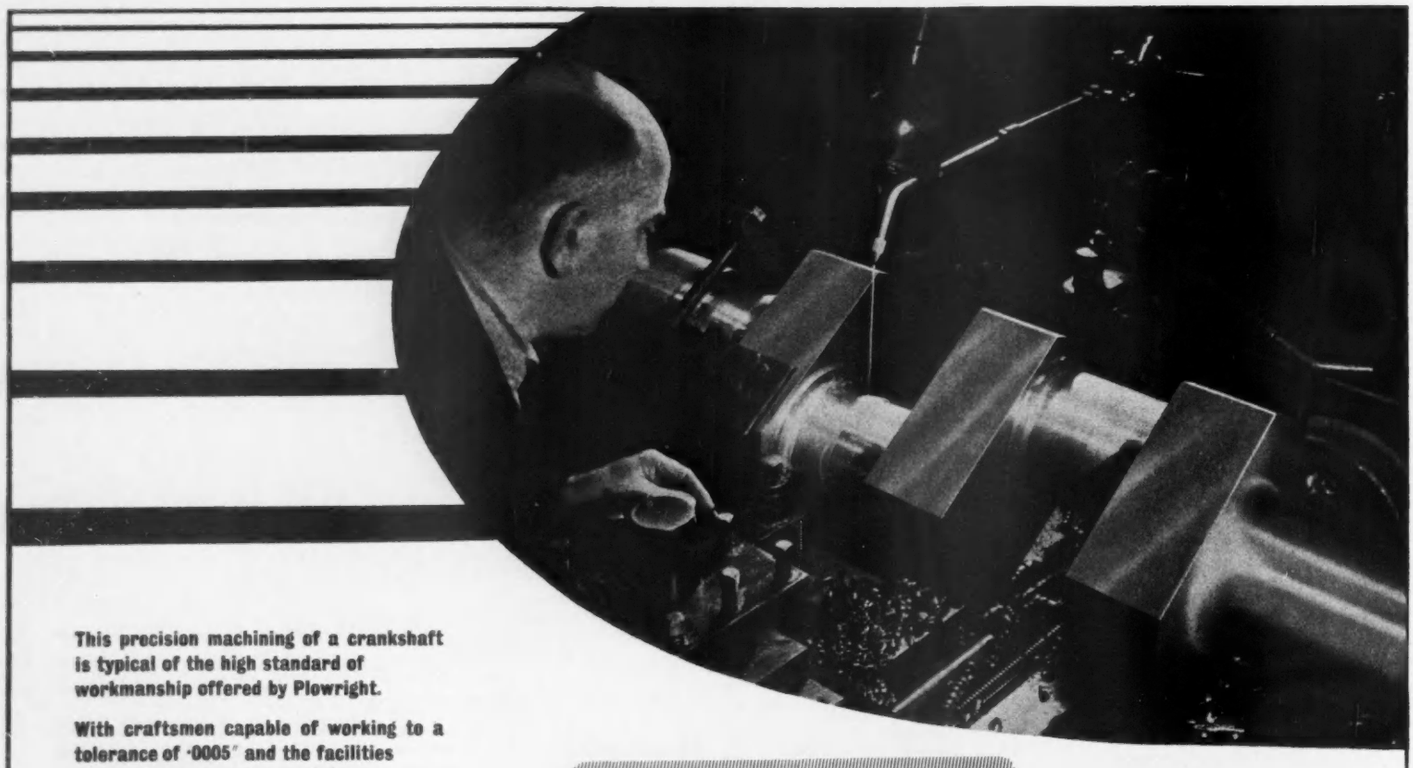
---

**YOU'RE ON THE TARGET IF YOU REMEMBER**

***WARDS might have it!***

**THOS. W. WARD LTD**
ALBION WORKS, SHEFFIELD

---



**This precision machining of a crankshaft is typical of the high standard of workmanship offered by Plowright.**

**With craftsmen capable of working to a tolerance of ·0005" and the facilities of modern engineering workshops, Plowright are able to undertake most types of machining and fabrication.**

**PLOWRIGHT**
BROTHERS LIMITED
ENGINEERS CHESTERFIELD
TELEPHONE 7161 TELEGRAMS 'PLOWRIGHT'

P.B. 24

AUCTIONEERS & VALUERS

ESTABLISHED 1877

LEOPOLD FARMER & SONS

conduct

AUCTION SALES

OF PLANT, MACHINERY AND INDUSTRIAL PROPERTIES

and

VALUATIONS

for Public Issue, Stock Exchange Quotation, Balance Sheet, Probate Insurance and other purposes.

FACTORY INVESTMENTS AND MORTGAGES ARRANGED

46, GRESHAM STREET, LONDON, E.C.2.

Telephone: Monarch 3422 (8 lines) Telegrams: Sites, London

HENRY BUTCHER AND CO.

Auctioneers, Valuers and Surveyors

Specialising in the

SALE & VALUATION of ENGINEERING & ALLIED WORKS PLANT & MACHINERY

73, Chancery Lane, London, W.C.2.

HOLBORN 8411 (8 lines)

FOR SALE

VALES PLANT REGISTER LIMITED

OFFER FOR IMMEDIATE SALE

One 1-ton Neals Mobile Crane, Ruston diesel engine, mounted on pneumatic tyres, 20ft. jib, fully slewing. In good order. £575. 0. 0d.

Two 2-ton Jones KL 22 Mobile Cranes, Ruston diesel engines, on pneumatics, 24ft. jibs. Recently overhauled. New 1947/48.

One Jones "Super 40" 3-ton Diesel Mobile Crane, 24ft. jib, Ruston engine, on pneumatics. Ex Ministry. Overhauled. £1275. 0. 0d.

Two 4/6-ton "QM" Neals Mobile Cranes, with 25/50ft. jibs, on pneumatics. New 1954/55. In good condition.

Two unused Butters 7-ton Single-Motor Electric Derrick Cranes, with 100ft. jibs, suitable for 400/440/3/50.

Three 7-ton Butters Steam Derrick Cranes, 100/120ft. jibs, two machines of grabbing type. All in very good condition.

One 10-ton Henderson Steam Derrick Crane, 100ft. jib. In good condition. Attractive price.

One 12½-ton Coles Petrol/Electric Fully Mobile Crane, with 45/80ft. jib. New 1950. Reconditioned recently. £5500. 0. 0d.

Further details: 14, Lower Grosvenor Place, London, S.W.1. Telephone: VICtoria 7531, 3501, 8080, 9886 (15 lines). E483 G

600

READY FOR DESPATCH

TWO NEW 970kW., 11,000/3/50, HARLAND & WOLFF Diesel-driven Alternator Sets, direct-coupled at 333 r.p.m., engine 1400 h.p., vertical, 6-cylinder, 4-stroke, makers type 640SB, with all standard ancillaries, starting equipment. Alternator is totally enclosed with ventilating ducts and connected to water cooler. Switchboard including exciter control with automatic voltage regulator. Alternators can be reconnected for other h.t. voltages.

GEORGE COHEN, SONS AND CO. LTD.
WOOD LANE, LONDON, W.12.
Tel.: Shepherds Bush 2070; and STANNINGLEY, Nr. LEEDS.
Tel.: Pudsey 2241. E205 G

AUCTIONEERS & VALUERS

Established 1850

WHEATLEY KIRK PRICE & CO.

E. L. JUDSON, F.R.I.C.S., F.A.I.
E. BEDDARD, A.I.MECH.E., F.A.L.P.A.
M. S. CHEAVIN, F.A.I.
G. E. GIBBS, F.A.L.P.A.

SURVEYORS, VALUERS and AUCTIONEERS of FACTORIES, PLANT and MACHINERY

FIRE LOSS ASSESSORS

9, REX PLACE, LONDON, W.1.

Telephone: HYDE PARK 8844/5/6 (3 lines)

*Established* 1807

FULLER, HORSEY SONS AND CASSELL

Specialists IN THE

SALE & VALUATION OF WORKS and MANUFACTORIES ENGINEERING PLANT and MACHINERY

10, LLOYD'S AVENUE LONDON E.C.3.

Telephone: ROYAL 4861

FOR SALE

LOCOMOTIVES FOR SALE.—A recent large purchase enables us to offer the following range of locomotives. Copies of insurance reports available on application.—R. S. Hayes, Limited, Bridgend, Glamorgan (Telephone, Bridgend 1311/2/3):—

| Item | Bore and stroke | Type and make | When built | Working pressure p.s.i. | Net weight, tons |
|---|---|---|---|---|---|
| 1 | 14½×24 | 040 Hawthorn Leslie | — | 160 | 22 |
| 2 | 14×22 | 040 Barclay | — | 160 | 22 |
| 3 | 14×22 | 040 Barclay | — | 160 | 22 |
| 4 | 14×22 | 040 Barclay | — | 160 | 22 |
| 5 | 14×22 | 040 Barclay | — | 160 | 22 |
| 6 | 14×22 | 040 Barclay | 1935 | 160 | 22 |
| 7 | 17×24 | 040 Bagnall | 1934 | 160 | 36 |
| 8 | 17×24 | 040 Bagnall | 1940 | 160 | 36 |
| 9 | 17×24 | 040 Bagnall | 1941 | 160 | 36 |
| 10 | 17×24 | 040 Bagnall | 1941 | 160 | 36 |
| 11 | 17×24 | 040 Bagnall | 1944 | 160 | 36 |
| 12 | 18×26 | 060 Bagnall | 1950 | 180 | 40½ |

E986 G

TANGYE HYDRAULIC PRESS

200 ton, 12in ram, 12in stroke, 3ft. daylight, bed 16ft. by 2ft. 6in. wide, complete with pump, electric S.R. motor and starter for 400/3/50.

NORMAC, LTD., Pepper Road, Leeds, 10.
Tel.: 77779. E993 G

UNUSED 22FT. BY 11IN. PLATE BENDING ROLLS, maximum thickness 2½in. by 6ft. cold bending. Top roll 32in. dia., two bottom rolls 18in. dia., 75 h.p. roll drive, 40 h.p. screw down. Weight 130 tons.—BOX No. B6030, "The Engineer." G

AUCTIONEERS & VALUERS

RICHARDS AND PARTNERS

Auctioneers, Surveyors and Valuers

Specialists in the

VALUATION & SALE of INDUSTRIAL PROPERTY PLANT and MACHINERY

3, Arundel Street, London, W.C.2.

TEMple Bar 7471

FOR SALE

MOBILE CRANES FOR SALE

One Rapier 8½-ton Super, diesel/electric, fully slewing, jibs to 50ft.

One Rapier 8½-ton Super, petrol/electric, fully slewing.

Two Rapier 6-ton standard petrol/electric, solid tyres, diesel conversion available.

One Morris 5-ton petrol/electric, solid tyres, diesel conversion available.

One Coles/Thornycroft 5-ton, 6×4 Diesel, Mark 7, wire derricking.

One Tate 5-ton Petrol/Electric, solid tyres.

One Coles 3-ton fully slewing, petrol/electric, on Crossley lorry chassis—cheap.

Two 2½-ton Morris Petrol/Electric, solid tyres. As new. Diesel conversion available.

One 2-ton Rapier full slewing, crawler mounted, diesel engine.

One 2-ton Hydracrane, petrol/hydraulic, on 4×4 high-speed chassis.

WILLIAM R. SELWOOD, LIMITED, CHANDLER'S FORD, HANTS.
'Phone: 2275. E9917 G

AUCTIONEERS & VALUERS

JOHN FOORD & COMPANY

VALUERS AND ASSESSORS OF WORKS, FACTORIES ENGINEERING PLANT AND MACHINERY

56, VICTORIA STREET LONDON, S.W.1.

VICTORIA 2002/3/4

*Established Over a Century*

KNIGHT, FRANK & RUTLEY

SALE & VALUATION OF FACTORIES PLANT AND MACHINERY

20, Hanover Square, W.1.

Telephone: MAYfair 3771

(Factory Department: Ext. 17)


E. R.

*By Order of the Minister of Supply*

## GOVERNMENT SURPLUS STORES

AUCTION PROGRAMME

| 1958 | | *Main Location* | *Auctioneers* |
|---|---|---|---|
| February 11–14 | Miscellaneous stores, including vehicles, machine tools, etc. | M.O.S. Storage Depot, Royal Arsenal, Woolwich, London, S.E. 18 | FULLER, HORSEY, SONS & CASSELL (Dept. L), 10, Lloyd's Avenue, London, E.C.3. (Tel.: Royal 4861.) |
| February 18–19 | Miscellaneous stores and machine tools | M.O.S. Storage Depot, Ruddington, Notts | WALKER, WALTON & HANSON (Dept. L), Byard Lane, Bridlesmith Gate, Nottingham. (Tel.: 47271.) |
| February 25–26 | Miscellaneous stores, including: | M.O.S. Storage Depot, Rotherwas, Hereford | RUSSELL, BALDWIN & BRIGHT, LTD. (Dept. L), 20, King Street, Hereford. (Tel.: 4366.) |

Foden, Ailsa Craig, Perkins, Kelvin and other marine engines, boat spares, M.T. spares, tyres, inner tubes, sparking plugs, dynamos, ball and roller bearings, voltmeters, ammeters, theodolites, rangefinders, wireless and electrical equipment, McLaren diesel engine, Stothert & Pitt concrete mixer, auto barbing machines, road roller, towing bars, oil smoke apparatus, ferrous and non-ferrous bar, sheet and tubing, trailer-mounted and other pumps, gauges, micrometers, tools, canvas covers, rubber hose, clothing, boots, etc.

| | | | |
|---|---|---|---|
| February 25 | 350 vehicles | 62 "B" Vehicle Depot, R.A.O.C., Eglinton Park, Irvine, Ayr. (Sale at Central Halls, Bath St., Glasgow, C.2.) | DIXON & WALLACE (Dept. L), Bank Buildings, Graham Square, Glasgow, E.1. (Tel.: Bridgeton 2447.) |
| February 27–28 | Machine tools, plant, canteen equipment, office furniture | Wm. Beardmore & Co., M.O.S. Agency Factory, Linwood Road, Paisley. (Sale at Linwood on February 27, and at Central Halls, 25, Bath Street, Glasgow, C.2, on February 28.) | SHIRLAW ALLAN & CO. (Dept. L), Keith Street, Hamilton. (Tel.: 63.) |
| March 5–6 | Machine tools and miscellaneous stores, including radio stores, lifting tackle, etc. | Technical Stores Depot, Old Dalby, Melton Mowbray, Leics. (Sale at Melton Mowbray.) | SHOULER & SON (Dept. L), 1, Norman Street, Melton Mowbray, Leics. (Tel.: 81.) |

CATALOGUES (6d. each—P.O.s) available *only* from the Auctioneers shown above.

SALES BY TENDER

(i) MACHINE TOOLS, lying at Cardiff, Glascoed and Dartmouth, include capstan, turret and centre lathes, horizontal and vertical millers, cylindrical, internal and surface grinders, gear hobber, radial drill, etc. (Tenders must be submitted by 24th February, 1958.)

(ii) HEAT-TREATMENT EQUIPMENT, lying at Monk Bretton, near Barnsley, Yorks, includes travelling plate charging machines, sheet tempering furnaces, loading gantries, transfer bogies, stoker coal-fired reheating furnaces and walking beam furnace, 80-ton douche press, electro-magnets, centrifugal pump giving 4320 g.p.m. with electric motor and ancillary equipment. (Application for Tender forms must be made before 14th February, 1958.)

Applications, stating which Tender form is required, should be made to Ministry of Supply, Directorate of Disposals, First Avenue House, High Holborn, London, W.C.1.

E975 J

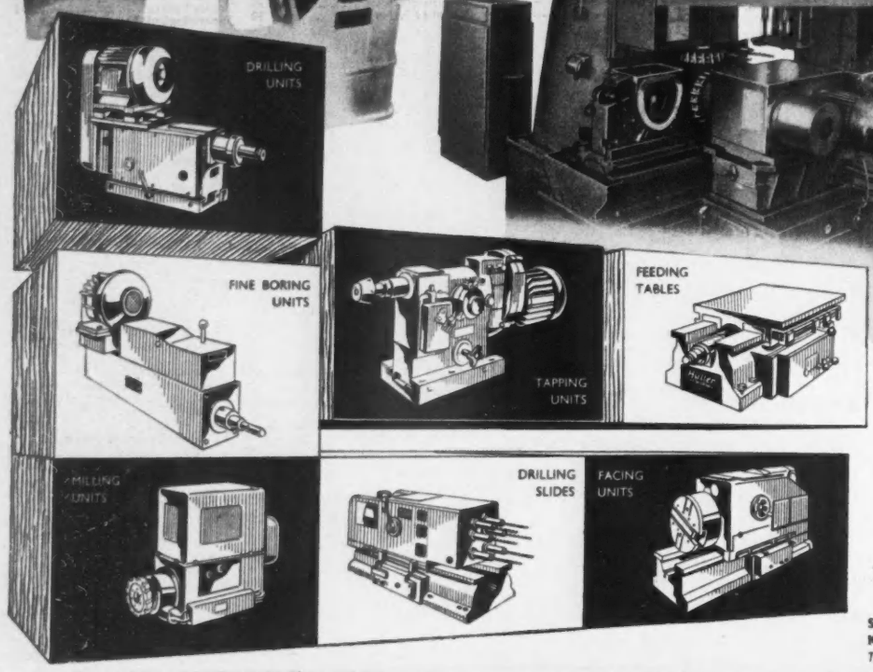
*Left, automatic transfer line drills and chamfers all oil ways in 4-cylinder crankshafts at 60 per hour.*

*Below, combined mill and drilling machine for transmission boxes.*

Karl Hüller G.m.b.H.
Ludwigsburg,
Germany.

**Hüller**

**Special Purpose Machines and Transfer Lines Composed of *Hüller* Standard Units**




**B.S.A Hüller**

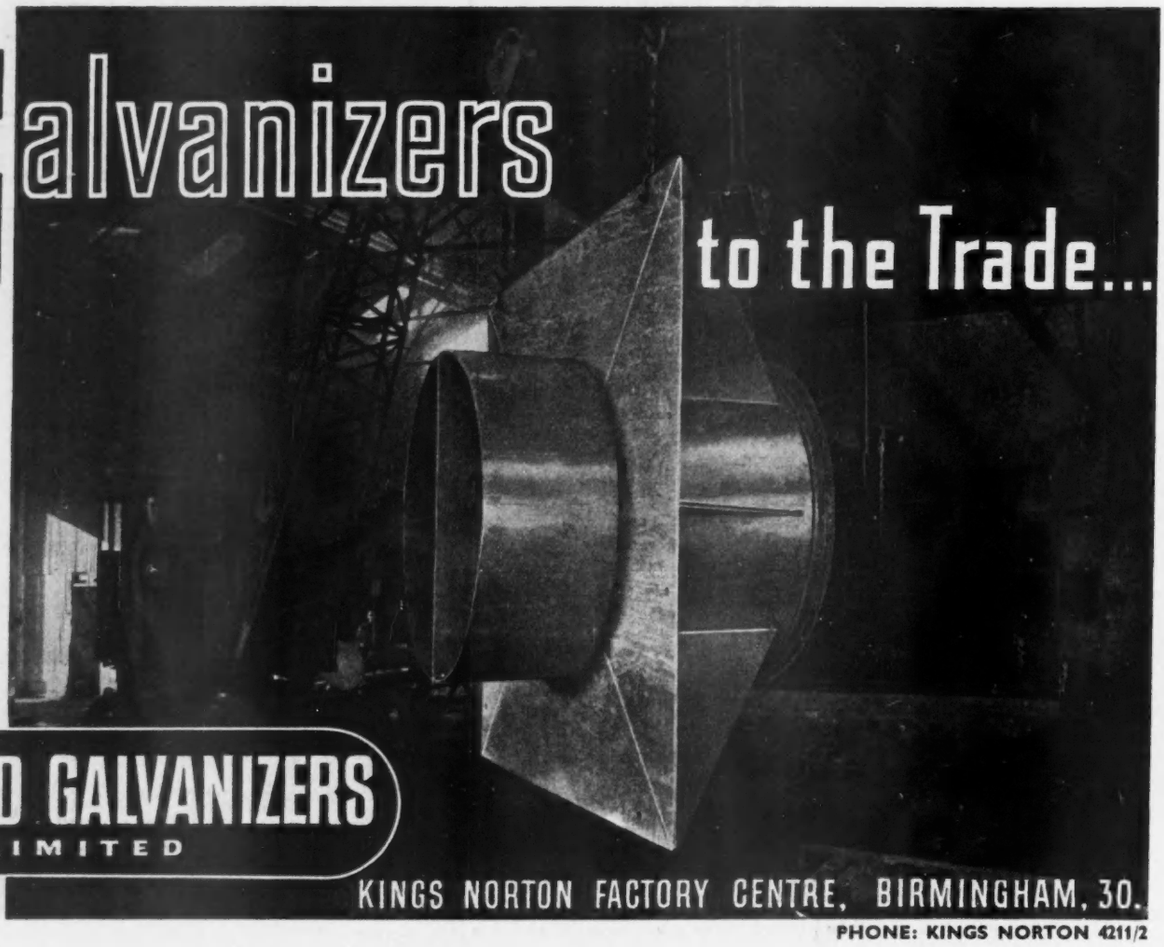
B.S.A. Tools Ltd.
Birmingham, 33.
England.

Karl Hüller G.m.b.H., of Ludwigsburg, Germany, have perfected a range of standard units which can be built up to provide individual special-purpose machines or, combined in groups, to form complete transfer lines. The Hüller principle has been applied with outstanding success to the production of a variety of components for numerous industries on the Continent, and by B.S.A. Tools Limited, of Birmingham, England, to the manufacture under licence from Karl Hüller G.m.b.H., of special-purpose machines for the medium or high production requirements of industries in Great Britain. The combined resources of these organisations is available to assist manufacturers in obtaining maximum economical output.

**SOLE AGENTS GT. BRITAIN: BURTON GRIFFITHS & COMPANY LTD. KITTS GREEN, BIRMINGHAM. 33.**
*Telephone: STECHFORD 3071*



# Galvanizers to the Trade...



*Our technical Staff will be pleased to deal with any Galvanizing problem you care to submit.*

**MIDLAND GALVANIZERS LIMITED**

KINGS NORTON FACTORY CENTRE, BIRMINGHAM, 30.

**PHONE: KINGS NORTON 4211/2**

# INDEX TO ADVERTISERS


PAGE

A.C.E. Machinery, Ltd. 94
Abingdon King Dick, Ltd. 38
Adcock & Shipley, Ltd. 120
Airnesco Products, Ltd. 63
Alldays & Onions, Ltd. 28
Allen, E., & Co., Ltd. 82
Armstrong Patents Co., Ltd. 88
Armstrong Stevens & Son, Ltd. 113
Armstrong Whitworth (Metal Industries), Ltd. 4
Automotive Engineering, Ltd. 122
Automotive Products Co., Ltd. 13
Avica Equipment, Ltd. 87

B.R.D. Co., Ltd. 121
B.S.A. Tools, Ltd. 148
Baldwin Instrument Co., Ltd. 53
Barimar Ltd. 15
Barlow-Whitney, Ltd. 134
Barron, W. S., & Son, Ltd. 32
Bates Bros (Engineers), Ltd. 35
Bennett & Sayer, Ltd. 59
Bird, W. H., & Sons, Ltd. 32
Birfield Industries, Ltd. 86
Birkett, F. W., & Sons, Ltd. 24
Birmingham & Blackburn Construction Co., Ltd. 54
Black & Decker, Ltd. 70
Booth, J., & Bros. 71
Booth, J., & Co., Ltd. 51
Braby, F., & Co., Ltd. 52
Brett's Patent Lifter Co., Ltd. 120
British Aluminium Co., Ltd. 107
British Constructional Steelwork Association Cover iv
British Electrical Repairs, Ltd. 81
British Paints, Ltd. 78
British Railways 131
British Twin Disc, Ltd. 120
Broadbent R., & Son, Ltd. 89
Broom & Wade, Ltd. 128
Brown, D., Corporation (Sales), Ltd. Cover i–15
Brown, E. G., & Co., Ltd. 120
Brownlie & Murray, Ltd. 59
Budworth, D., Ltd. 49
Burrell, E. C., & Sons, Ltd. 137
Butcher, H., & Co. 147

Caird & Rayner, Ltd. 81
Callow, F. E. (Engineers), Ltd. 114
Cambrian Wagon & Engineering Co., Ltd. 74
Carron Co. 117
Carruthers, J. H., & Co., Ltd. 80

PAGE

Chesterfield Tube Co., Ltd. 110
Clarke, Chapman & Co., Ltd. 83
Clyde Crane & Booth, Ltd. 71
Clyde Crane & Engineering Co. 71
Clyde Tube Forgings, Ltd. 97
Cochran & Co., Annan, Ltd. 42
Cohen, G., Sons & Co., Ltd. Cover iii–58
Consett Iron Co., Ltd. 138
Cooper & Co. (B'ham), Ltd. 113
Cory Brothers & Co., Ltd. 78
Cowans Sheldon & Co., Ltd. 35
Crockatt, W., & Sons, Ltd. 20
Crofts (Engineers), Ltd. 104–105
Crompton Parkinson, Ltd. 116
Cross Manufacturing Co. (1938), Ltd. 78
Crowthorn Engineering Co., Ltd. 89
Curran, E., Engineering, Ltd. 44

DEW 17
Danite Hard Metals, Ltd. 68
Deloro Stellite, Ltd. 101
Dilloway, P. W., Ltd. 12
Donovan Electrical Co., Ltd. 124
Drum Engineering Co., Ltd. 99
Drummond - Asquith (Sales), Ltd. 95

Electronic Engineering 31
Ellison, G., Ltd. 6
Eyre Smelting Co., Ltd. 96

Fairitt Engineering Co., Ltd. 24
Farmer, L., & Sons 147
Farrar Boilerworks, Ltd. 50
Ferguson Pailin, Ltd. 91
Finucane, W., Ltd. 120
Firkins, G. & A., Ltd. 131
Foord, J., & Co. 147
Forster, T. S., & Sons, Ltd. 137
Fraser & Chalmers Engineering Works 61
Fuller, Horsey, Sons & Cassell 147

Gandy, Ltd. 17
General Electric Co., Ltd. 61–100
Gibson, A. L., & Co., Ltd. 17
Glenboig Union Fire Clay Co., Ltd. 59
Glenfield & Kennedy, Ltd. Cover ii
Goodwin, R., & Sons (Engineers), Ltd. 132
Goodyear Pumps, Ltd. 14
Grafton Cranes, Ltd. 37

PAGE

Grazebrook, M. & W., Ltd. 149
Greenwood's Standard Gear Cutting Co., Ltd. 89
Griffiths, Gilbart, Lloyd & Co., Ltd. 88

Hackbridge & Hewittic Electric Co., Ltd. 18
Halesowen Steel Co., Ltd. 60
Harbutt's Plasticine, Ltd. 114
Harland & Wolff, Ltd. 124
Harlow, R., & Son, Ltd. 28
Harvey, G. A., & Co. (London), Ltd. 98
Head Wrightson Processes, Ltd. 119
Heap, J., & Co., Ltd. 18
Heatrae, Ltd. 73
Heywood, W. H., & Co., Ltd. 33
Hill-Alzen (Sales), Ltd. 36
Holst & Co., Ltd. 41
Horseley Group 112
Hughes - Johnson Stampings, Ltd. 74

Ilford, Ltd. 48
Imperia Aggregatebau Autohaus Muller oHG 90
Ince Forge Co. 18
International Combustion, Ltd. 26
IVO Engineering & Construction Co., Ltd. 60

Jackman, J. W., & Co., Ltd. 93
Johnson & Phillips, Ltd. 85

Keelavite Rotary Pumps and Motors, Ltd. 46
Kempe's Engineers Year-Book 141
Kestner Evaporator & Engineering Co., Ltd. 96
Kitchen & Wade, Ltd. 63
Knight, Frank & Rutley 147

Lafarge Aluminous Cement Co., Ltd. 62
Lake & Elliot, Ltd. 92
Langley Alloys, Ltd. 136
Laurence Scott & Electromotors, Ltd. 3
Ledward & Beckett, Ltd. 77
Leeds Engineering & Hydraulic Co., Ltd. 37
Lethaby, W., & Co., Ltd. 131
Lionweld, Ltd. 8
Lloyd, R., Ltd. 20

PAGE

Lobnitz & Co., Ltd. 57
Londex, Ltd. 90
Loveridge, Ltd. 59

Machinery Installations, Ltd. 92
MacLellan, P. & W., Ltd. 117
McNeil, C., Ltd. 93
Mallinson & Eckersley, Ltd. 149
Mancuna Engineering, Ltd. 9
Markland Scowcroft, Ltd. 47
Massey, B. & S., Ltd. 123
Matthew Hall Group of Companies 84
Matthews & Yates, Ltd. 72
Mavor & Coulson, Ltd. 64
Megator Pumps & Compressors, Ltd. 106
Mercer, T., Ltd. 89
Meritus (Barnet), Ltd. 32
Metallic Valve Co., Ltd. 110
Metropolitan-Cammell Carriage & Wagon Co., Ltd. 114
Metropolitan - Vickers Electrical Co., Ltd. 133
Midland Galvanizers, Ltd. 148
Mills, G. (Engineers), Ltd. 78
Mirrlees (Engineers), Ltd. 8
Mobil Oil Co., Ltd. 19
Morgan Crucible Co., Ltd. 22

National Coal Board 129
Negretti & Zambra, Ltd. 115
Neill, J., & Co. (Sheffield), Ltd. 31
Newall, A. P., & Co., Ltd. 42
Newman Industries, Ltd. 135
Niagara Screens (Great Britain), Ltd. 113
Non-Ferrous Die Casting Co., Ltd. 100
Norris Brothers, Ltd. 77
North British Rubber Co., Ltd. 10
Norton, Sir J. Farmer & Co., Ltd. 5

Oddie Bradbury & Cull, Ltd. 137
Opperman Gears, Ltd. 108
Oscard, J., & Co. 28

Parsons, C. A., & Co., Ltd. 25
Peckett & Sons, Ltd. 81
Phillips, B. L. & N., Ltd. 53
Pinchin, Johnson & Co. 131
Platt Malleable Castings, Ltd. 130
Plowright Bros., Ltd. 146
Pollard, F., & Co., Ltd. 70

PAGE

Positive Lock Washer Co., Ltd. 90
Power Flexible Tubing Co., Ltd 137
Prestons, Ltd 37
Price, J. T., & Co., Ltd. 20
Priest Furnaces, Ltd. 29

Radiovisor Parent, Ltd. 54
Railway Mine & Plantation Equipment, Ltd. 45
Rawlplug Co., Ltd. 7
Reavell & Co., Ltd. 73
Record Electrical Co., Ltd. 129
Renold Chains, Ltd. 39
Renshaw Foundry, Ltd. 109
Revolvo, Ltd. 2
Reyrolle, A., & Co., Ltd. 102
Rhodes, B., & Son, Ltd. 132
Rhodes, J., & Sons., Ltd. 7
Rice & Co. (Leeds), Ltd. 130
Richards, J., & Sons, Ltd. 136
Richards & Partners 147
Richmond Welding Co. 89
Robertson & Ferguson, Ltd. 5
Robinson, L., & Co. (Gillingham), Ltd. 70
Robson, G., & Co. (Conveyors), Ltd. 114
Rockwell Machine Tool Co., Ltd. 54
Rocol, Ltd. 40
Rose Bros. (Gainsborough), Ltd. 109
Ruhrstahl, A. G. 126
Russell, G., & Co., Ltd. 149
Ruston & Hornsby, Ltd. 150
Rye, Claude, Bearings 18

Sadi Engineering Co., Ltd. 57
St. Georges Engineers, Ltd. 41
Sale, H. B., Ltd. 90
Saunders Valve Co., Ltd. 43
Schiefdrop & Co., Ltd. 81
Schiess, A.G. 11
Sespa, U.K., Ltd. 27
Shaw Petrie, Ltd. 97
Sheffield Forge & Rolling Mills Co., Ltd. 30
Shotton Bros., Ltd. 77
Simon Handling Engineers, Ltd. 79
Skefko Ball Bearing Co., Ltd. 76
Smedley Bros., Ltd. 120
Smith, J. (Keighley), Ltd. 111
Smith, S., & Sons (England), Ltd. 77

PAGE

Smiths Industrial Instruments, Ltd. 127
South Durham Steel and Iron Co., Ltd. 65
Stainless Steel Wire Co., Ltd. 130
Standard Piston Ring & Engineering Co., Ltd. 132
Steele & Cowlishaw, Ltd. 117
Steelway, Ltd. 69

Tangyes, Ltd. 49
Taylor & Hubbard, Ltd. 32
Taylor Stoker Co., Ltd. 31
Technological Institute of Gt. Britain 140
Thompson, J., Group 66
Thorn, J., & Sons, Ltd. 99
Tonks, J., & Co., Ltd. 89

Unbrako Socket Screw Co., Ltd. 63
United States Metallic Packing Co., Ltd. 113

Vanguard Valve Co., Ltd. 38
Vaughan, A. J., & Co. (Mitre Works), Ltd. 100
Visco Engineering Co., Ltd. 2
Vokes, Ltd. 118

Walker, P. M. & Co. (Halifax), Ltd. 69
Wallsend Slipway & Engineering Co., Ltd. 21
Ward, T. W., Ltd. 16–50–146
Watson, H. T., Ltd. 129
Weir, G. & J., Ltd. 75
Weldall & Assembly, Ltd. 125
Welding Technical Services, Ltd. 138
Wellman Bibby Co., Ltd. 59
Wellman Smith Owen Engineering Corporation, Ltd. 55
Weston, C., & Co., Ltd. 67
Westool, Ltd. 88
Wharton Crane & Hoist Co., Ltd. 34
Wheatley Kirk, Price & Co. 147
Whitehouse Industries, Ltd. 23
Wiggin, H., & Co., Ltd. 93–99
Wiggins, F., & Sons 149
Wood, E., & Co., Ltd. 56
Woodfield Hoist & Associated Industries, Ltd. 132
Wootton Bros. Ltd. 90
Worthington-Simpson, Ltd. 103
Wynstruments, Ltd. 96

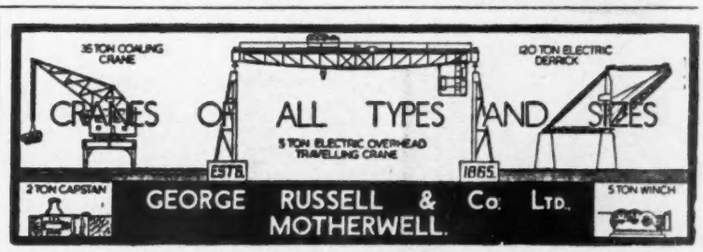


# PITCH PINE

The engineer's Timber
affording highest strength with natural durability

Large sections a speciality

**MALLINSON & ECKERSLEY LTD.,**
PITCH PINE SPECIALISTS
23, BLANTYRE STREET, CHESTER ROAD, MANCHESTER 15
TELEPHONE: DEANSGATE 5867-9 TELEGRAMS: 'PITCH PINE' MANCHESTER




# MICA

FOR INSULATION
WATER GAUGES,
ETC.

**F. WIGGINS & SONS**
Phone: SYDenham 7660
9-11 TREDOWN ROAD, SYDENHAM, S.E.26
Established 1840

# M & W GRAZEBROOK DUDLEY WORCESTERSHIRE

LIMITED EST. 1750
Tel: DUDLEY 2431-3 Telegrams: GRAZEBROOK DUDLEY

MAKERS OF

HEAVY IRON CASTINGS UP TO 20 TONS
CLASS I VESSELS AND RAILWAY TANK WAGONS
STEEL FABRICATIONS FOR NUCLEAR POWER PLANT
STAINLESS STEEL AND ALUMINIUM PRESSURE VESSELS
HOT PRESSINGS UP TO 1¼" THICK × 11 FT. DIA.
CHEMICAL PLANT. HOMOGENEOUS LEAD LININGS

# "From now on, we're working *through!*"

*Another site. Another tight schedule.* But right from the word go there'll be round-the-clock power for day and night working . . . . *reliable, independent power* supplied by a Ruston-Paxman diesel generating set.

Ruston-Paxman diesel generating sets give that *extra* power service because they have so much more to offer . . . they are easily transportable and quick to install . . . they have the stamina for working on and on, under the toughest conditions . . . they are backed by a first-class day and night service.

These versatile units are in widespread service for independent and standby power. For instance, they're on a port construction scheme in Africa and on emergency standby at London Airport . . . they're serving in the Persian oilfields and in North American skyscrapers . . . they're supplying electricity to cotton mills in Pakistan and ensuring power continuity for I.T.V. in London.

**RUSTON-PAXMAN** **diesel generating sets**

**100 - 1288 kVA**

RUSTON & HORNSBY LTD · LINCOLN · ENGLAND · *Associated with Davey, Paxman & Co. Ltd., Colchester.*

PRINTED BY GEORGE REVEIRS, LTD., 10/12, ROSEBERY AVENUE, LONDON, E.C.1, FOR THE PROPRIETORS, MORGAN BROTHERS (PUBLISHERS), LTD., 28, ESSEX STREET, STRAND, LONDON, W.C.2. 84/1/24

# SCRAP
# for
# COHEN'S
# COHEN'S
# for
# SCRAP

THE 600 GROUP OF COMPANIES

**GEORGE COHEN**
SONS AND COMPANY LIMITED

**RAW MATERIALS DIVISION**

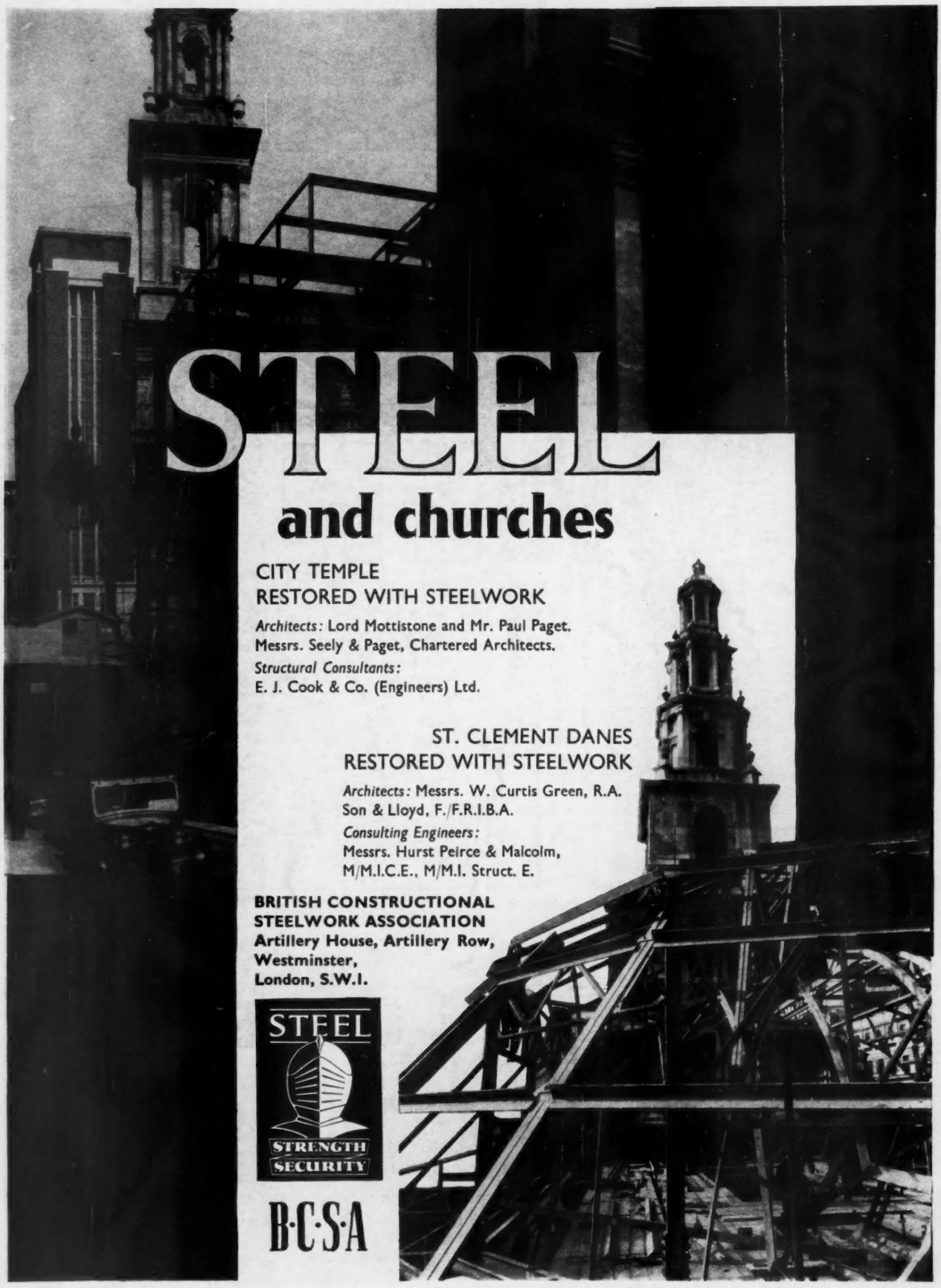
*Experts in Scrap since 1834*

WOOD LANE, LONDON, W.12 · *Telephone:* Shepherds Bush 2070 · *Telegrams:* Coborn, Telex, London
And at 600 Commercial Road, E.14 · Bidder Street, Canning Town, E.16 · Bath · Belfast · Birmingham · Hebburn-on-Tyne · Leeds
Luton · Manchester · Sheffield · Swansea

GCS/RM

The Engineer

FEBRUARY 7, 1958

# STEEL
## and churches

CITY TEMPLE
RESTORED WITH STEELWORK

*Architects:* Lord Mottistone and Mr. Paul Paget.
Messrs. Seely & Paget, Chartered Architects.
*Structural Consultants:*
E. J. Cook & Co. (Engineers) Ltd.

ST. CLEMENT DANES
RESTORED WITH STEELWORK

*Architects:* Messrs. W. Curtis Green, R.A.
Son & Lloyd, F./F.R.I.B.A.
*Consulting Engineers:*
Messrs. Hurst Peirce & Malcolm,
M/M.I.C.E., M/M.I. Struct. E.

**BRITISH CONSTRUCTIONAL STEELWORK ASSOCIATION**
**Artillery House, Artillery Row, Westminster, London, S.W.1.**

STEEL
STRENGTH
SECURITY

B·C·S·A